Proposal for a Master of Engineering (MEng) Program in Electrical and Computer Engineering (ECE) at Duke Kunshan University (DKU)

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Executive Summary

Objective: The Pratt School of Engineering is proposing a 2-year MEng program in ECE at DKU. Students will spend their first year at DKU and second year at Duke and will receive a Duke MEng degree. The program will be jointly managed by both Duke and DKU, with faculty at Pratt ensuring that the program is of the high quality required for a Duke degree. The program will be targeted especially to students who desire an educational experience in both China and the U.S.

Motivation: ECE focuses on the topics of both hardware and software that impacts the daily life for everyone on this planet: smart phone, search engine, electrical vehicle, etc. As the industry in China is being upgraded from labor-intensive production to high-tech business, there emerge enormous opportunities for US universities to participate in education and research in China. DKU is currently developing a new Institute of Applied Physical Sciences and Engineering (iAPSE) for interdisciplinary collaboration, global leadership, and knowledge in service to society. iAPSE is expected to be a robust enterprise to bridge Duke and DKU to make broad impacts. Developing iAPSE represents our *strategic vision* to access the enormous opportunities in China for interdisciplinary education, transformative research and global leadership. Under the umbrella of iAPSE, the proposed ECE MEng program, focusing on professional education and training, is an initial step to implement our long-term vision.

Description: The proposed ECE MEng program aims to recruit top ECE students in China and other neighboring countries, emphasize international experience and contexts, and train students to become global technical leaders. Students will spend the first year at DKU and the second year at Duke. At the end of the second year, students receive a Duke MEng degree in ECE and have the option to work for US industry to further expand their working experience and industrial knowledge. With the study and internship experience in China or other neighboring countries, our students are trained to become valuable human resources for global companies that are heavily engaged in international business (e.g., Google, Microsoft, etc. in China). The number of students will gradually grow from 25 to 100 over 5 years. At DKU, 4.5 faculty members (4.5 FTE), 3 staff members (2.5 FTEs with 2 full-time staff members and 1 part-time staff members), 2 language instructors (2 FTEs) and 4 teaching assistants (4 FTEs) will be recruited. At Duke, 4.5 faculty members (4.5 FTEs), 2 staff members (2 FTEs), 1.5 instructors for industrial preparation courses (1.5 FTEs) and 2 language instructors (2 FTEs) will be recruited. Meanwhile, we will actively work with multiple academic units at both Duke and DKU to prepare the required resources for these students, including spaces, libraries, student supports, etc. Accreditation and assessment will also be carefully planned and implemented.

The proposed ECE MEng program offers integrated classroom education and professional training and prepares students for active engagement in devising solutions to global technical challenges. It carries a number of attractive features, including customized curriculum, access to Duke campus and degree, networking and internship in China or other neighboring countries, and access to US job market. Based upon these highly competitive features, we are confident that the proposed program can boost academic reputation, establish global leadership and attract top talent for both Duke and DKU.

Proposal for a Master of Engineering (MEng) Program in Electrical and Computer Engineering (ECE) at Duke Kunshan University (DKU)

1. Rationale

1.1. What is ECE?

ECE is a field of applied science and engineering that is composed of two sub-areas: (1) Electrical Engineering (EE) and (2) Computer Engineering (CE). EE generally deals with the topics of electricity, electronics, and electromagnetism. CE integrates several fields of electrical engineering and computer science required to develop computer hardware and software.

ECE students are often trained in both hardware and software, instead of software engineering only. Based on the report from the US Department of Labor, there are about 3.3M new jobs in the ECE field every year. Most ECE graduates become the technical leaders or engineering managers at industrial companies or start-ups.

Today, the field of ECE has been aggressively expanded to a number of emerging application domains, including big data, robotics, internet-of-things, implantable devices, etc. ECE technologies have been adopted and commercialized to make broad impacts on everyone on this planet: smart phone, search engine, electrical vehicle, virtual reality, etc. They also make critical contributions to numerous interdisciplinary areas related to health informatics, advanced manufacturing, smart community, etc.

1.2. ECE in China

Industrial Development

A large number of Chinese companies in the ECE field have been aggressively growing over the past two decades, including Alibaba ($257B), Tencent ($253B), China Mobile ($248B), etc. The market capitalization of these Chinese companies has now become comparable to the leading US companies such as Apple ($621B), Google ($530B), Microsoft ($446B), etc. Recently, operation costs in China have been substantially increased, nearly reaching 50% of US costs, primarily due to the sharp increase of real estate price in large cities.

Driven by high operation costs, most Chinese companies, as well as those R&D centers in China operated by US companies (e.g., GM Shanghai), are actively seeking a transformative revolution of upgrading their labor-intensive production to high-tech business. Towards this goal, a close partnership with leading-edge research universities is necessary to facilitate talent training and technology development. However, most local universities in China do not have a globally competitive profile in engineering education and research to play such a critical role of industrial transformation. It, in turn, brings up enormous opportunities for US universities to take global leadership and make broader impacts in China.

Higher Education

China has been educating a large population of engineering students every year. The total

number of undergraduate enrollment across all majors is around 21-22M for both US and China. However, only 10% of students choose engineering majors in the US, while the percentage of engineering students reaches 35% in China. A majority of these engineering students are in the ECE field.

After finding an entry-level job in China, most engineering students graduated from a Chinese university receive relatively low payment compared to those in the US. The annual salary for an entry-level software engineer at Google is $27,388 and $118,884 in Shanghai (China) and San Jose (US) respectively (www.glassdoor.com), while the living cost is similar. For instance, the living cost in Durham is only 6% higher than that in Shanghai (www.expatistan.com). For this reason, instead of immediately pursuing their career development in China, many Chinese students choose to seek high-quality education and explore well-paid job opportunities in the US.

A recent report published by the Chinese Ministry of Education (MOE) in 2015 claims that about 400,000 Chinese students leave China to study aboard every year and about one third of these students are in engineering majors. These Chinese students are mostly from middle-class families. Their parents can easily afford the expensive tuition for US education by taking advantage of the rapidly increased housing price in China. The real estate price has grown by 10× over the past 15 years in Chinese big cities. For instance, it is not uncommon for a middle-class family in Shanghai to own 2-3 apartments and each apartment with 900 ft^2 is worth more than $1M. On the other hand, the education cost for a 2-year MEng degree in US is about $100-150K, including tuition, textbook, living expense, health insurance, etc. These data imply enormous opportunities for global education by attracting high-quality engineering students from China.

On the other hand, the same report from the Chinese Ministry of Education (MOE) also points out that about 300,000 Chinese students return to China and find a local job in China every year, after they have worked in another country for a few years and acquired sufficient industrial experience. Most of them work for international companies that are heavily engaged in business in China (e.g., Google, Microsoft, etc.). Many international companies offer global pay for senior technical or management positions. Namely, the pay scale is similar between China and US. For instance, the annual salary for an engineering director at Google is $247,177 and $242,699 in Shanghai (China) and San Jose (US) respectively.

For this reason, a large number of Chinese students want to return to China eventually, when they find excellent career opportunities in China after staying in US for several years. In addition to the motivation driven by career development, staying with their parents is another important reason why Chinese students would prefer to return to China, especially when their parents become old and cannot be self-supported. It is extremely valuable for these students to participate in a global master program with close connection to Chinese industry (e.g., through summer internship in China) so that they are exposed to the local culture and social network in China.

Even for the students who work for international companies in US, they are often required to

interact with their colleagues and/or customers in China. Hence, carrying study and work experience in China is highly appreciated by their employers. We have contacted a number of international companies in US and many of them expressed the importance of working experience in China for their employees, as shown by the survey outcome in Appendix.

The aforementioned facts imply that there is an immediate need to establish a global ECE MEng program, as the conventional programs in either China or US are not specifically designed to offer the international education experience required for global technical leaders working over multiple countries.

1.3. Engineering Education and Research at DKU

DKU is a Sino-American partnership of Duke University and Wuhan University to create a world-class liberal arts and research university offering a range of academic programs for students from China and throughout the world. As a non-profit, joint-venture institution, DKU was granted accreditation approval by China's Ministry of Education in September 2013 and welcomed its inaugural class of students in August 2014.

DKU serves as a bridge to closely connect Durham to China, offering a variety of opportunities for student recruitment, research collaboration, etc. It facilitates faculty and students at Duke to access numerous resources in China to grow ECE and, more generally, engineering in long term. Towards this goal, DKU is developing a new Institute of Applied Physical Sciences and Engineering (iAPSE). iAPSE will build education programs and research centers to offer a variety of education and research opportunities with service to society. iAPSE will also serve as a bridge to closely connect Duke and DKU and help Duke to explore a broad spectrum of opportunities for international education, interdisciplinary research, culture development and technology transfer in China, eventually bringing the strength and reputation of Duke to the global world. The overall structure of iAPSE is shown in Figure 1, pursuing three critical missions: (1) interdisciplinary collaboration, (2) global leadership, and (3) knowledge in service to society.

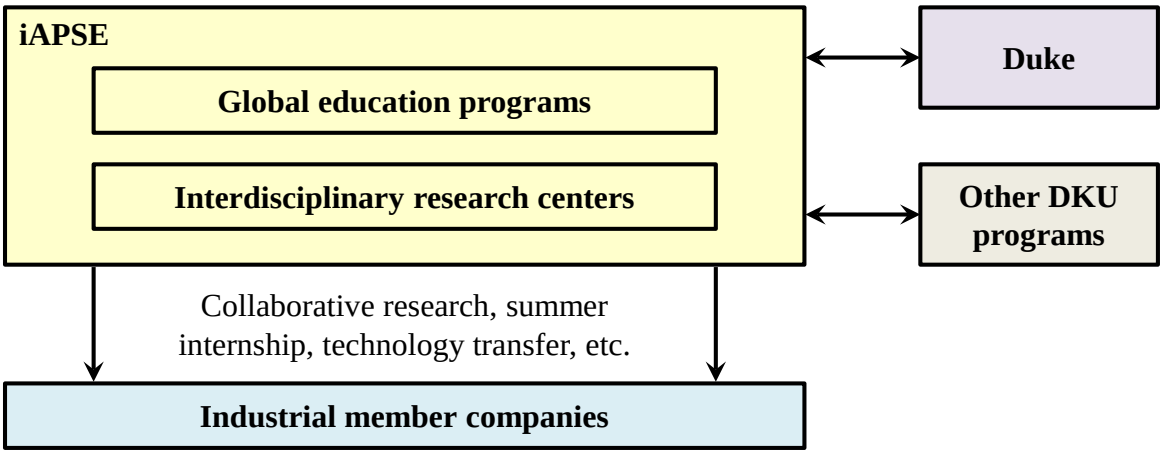

Figure 1. Overall structure of Institute of Applied Physical Sciences and Engineering (iAPSE)

Interdisciplinary Collaboration

Different from the conventional administrative setup for schools and departments, iAPSE forms a shared home of faculty, staff and students from interdisciplinary domains, including both engineering and non-engineering fields, for close collaboration. Duke has successfully created numerous interdisciplinary hubs that encourage collaboration across school boundaries, including Duke Global Health Institute, Information Initiative at Duke, Duke MEDx, etc. iAPSE emphasizes and demonstrates the importance of interdisciplinary collaboration that would impact and benefit our students over their entire career life. In particular, the following 4 technical areas will be explored with high priority due to the technical expertise and strength owned by Duke and the strong growth of these areas in China: (1) computer engineering, (2) data analytics, (3) image and vision, and (4) robotics.

- *Computer engineering* integrates several fields of electrical engineering and computer science required to develop computer hardware and software. Computer engineering techniques have been adopted and commercialized for numerous products that impact our daily life: smart phone, search engine, electrical vehicle, virtual reality, etc. Computer engineering is one of the major focus areas of Duke ECE (http://ece.duke.edu/faculty/computer-engineering), with more than 10 faculty members working on leading-edge education and research. Among them, Prof. Xin Li has recently been recruited from Carnegie Mellon University to join Duke ECE and has served as the Director of iAPSE at DKU. In China, computer engineering has been ranked as one of the ten most popular fields for education and research by the Chinese Ministry of Education (MOE). Prof. Xin Li is expected to lead and grow this emerging area at DKU.
- *Data analytics* is the process of inspecting, cleaning, transforming, and modeling data with the goal of discovering useful information, suggesting conclusions, and supporting decision-making. While data analytics is an interdisciplinary field, researchers in engineering can develop diverse algorithms, methodologies and tools in this area that broadly impact sciences, arts, engineering, business and medicine. The Information Initiative at Duke (IID) was recently launched to explore this emerging topic (http://bigdata.duke.edu/). In addition to IID, the Mathematics Department at Duke also carries a large group of experts in this area (https://math.duke.edu/). China has been aggressively investing and growing data analytics. In 2015, the State Council of China has identified big data analytics as one of the key strategic areas based upon which China is expected to grow its national industry and economy over the next ten years. In this area, Prof. Ming Li has recently been recruited from the Joint Engineering Institute of Carnegie Mellon University and Sun Yat-sen University and will join DKU in March 2018. Furthermore, Prof. Robert Calderbank (Director of IID), Prof. Jonathan Mattingly (Chair of Math) and Prof. Jian-Guo Liu (Professor of Math/Physics) have all expressed strong interests to explore the education and research opportunities at DKU based upon the technical strength carried by Duke in this promising area.
- *Image and vision* techniques aim to sense, process, transmit and store high-resolution image and video by developing application-specific hardware systems and software tools. These techniques form the foundation of many emerging applications such as gigapixel camera, virtual

reality, etc. In this area, Duke has the world-renowned Fitzpatrick Institute of Photonics (https://fitzpatrick.duke.edu). Most importantly, Prof. David Brady from ECE is a domain expert and has been extensively collaborating with DKU and local industry to explore the tremendously growing market in China. Taking virtual reality as an example, its market size in China is expected to grow from $0.23B to $8.2B (more than 35×) over the next 5 years. Prof. David Brady is expected to lead the growing area of image science and vision technology at DKU.

- *Robotics* is an interdisciplinary area involving computer science, electrical engineering, mechanical engineering, etc. It deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing. Today, robotics techniques have been extensively adopted by a broad range of applications, including smart manufacturing, autonomous driving, etc. Duke has a world-class research group on robotics (https://robotics.pratt.duke.edu) with more than 10 faculty members from four different departments: BME, CS, ECE and MechE. In China, robotics has been recognized as one of the core technologies to upgrade the current labor-intensive industry to smart manufacturing.

Global Leadership

The global structure of education and research dynamically changes over time. At Duke, there are 11% and 23% international students for undergraduate and graduate programs respectively based on the statistics data in 2012. iAPSE plans to closely collaborate with multiple schools and departments at Duke to take advantage of the unique opportunity of physically being in China. Our goal is to add the global component to the current infrastructure of student recruitment and training, resource sharing, technology transfer, etc., and, eventually, establish global leadership for Duke and DKU. This mission aligns with the global vision for development and growth set by Duke (www.global.duke.edu).

Knowledge in Service to Society

iAPSE plans to build strategic partnership with both domestic and international companies in China for education and research. These industrial member companies carry leading-edge technologies in the ECE field (e.g., Google, Microsoft, etc.). They can provide extensive opportunities for collaborative research, summer internship, technology transfer, etc., facilitating knowledge transfer in service to society. Enabling engineering students to access the state-of-the-art technologies from leading-edge companies through summer internship, complementary to the traditional classroom education, would make a long-lasting impact on their career development. For these reasons, our strategy of developing a local community with industrial partners is expected to benefit both students and faculty members in the long term.

Strategic Plan for Growing iAPSE

While iAPSE has an ambitious vision, it must be gradually built by adding one component at one time. In this proposal, we propose to develop the ECE MEng program, focusing on

professional education and training, as the very first step of growing iAPSE. When working on the ECE MEng program, iAPSE will recruit faculty, staff and students and secure other infrastructures and resources that are critical for future growth. Once the ECE MEng program is established, it is expected to play a critical role in providing world-class human resources to facilitate industrial transformation in China where labor-intensive industry is upgraded to high-tech business. It is also expected to help Duke and DKU recruit top talent to serve the global world. After demonstrating a successful ECE MEng program, iAPSE is expected to develop other education program, as well as growing into other applied science and engineering fields. In the long term, iAPSE, collaborating with other programs at Duke and DKU, is expected to initiate, drive and lead the "Eastern Silicon Valley" with high-tech industry in Asia.

1.4. Establishing ECE MEng Program at DKU

The ECE program at Duke is the home of world-class education and research, characterized by a firm engineering foundation, grounded by the classes and experience of Duke's unique environment on liberal arts. The Duke ECE department currently has 237 undergraduate students, 100 MS/MEng students and 161 PhD students. These ECE students acquire not only engineering breadth and depth, but also superior communication skills, with an appreciation for how engineering fits within broader society. After graduation, they often achieve leadership roles in a wide array of fields. In addition to working for academic universities, research labs and industrial companies in the engineering field, many Duke ECE graduates pursue their careers in other fields such as business, law, and medicine.

Duke ECE has also been pursuing interdisciplinary research projects by collaborating with other departments across the Pratt School of Engineering, the Trinity College of Arts and Sciences, the School of Medicine, etc. Today's ECE department serves as an important contributor to applied science and engineering at Duke.

Based upon the current strength of interdisciplinary education and research at Duke ECE, we propose to establish an ECE MEng program at DKU to accomplish the following missions. First, the proposed ECE MEng program, along with other programs at DKU, is expected to make impactful contributions to talent training in China, facilitating Duke and DKU to become global leaders. Second, DKU is expected to collaborate with Duke to recruit top ECE students in China and other neighboring countries and grow them to become global technical leaders in the ECE area, thereby implementing the global vision for Duke.

Note that the proposed ECE MEng program at DKU does not simply replicate the existing ECE program at Duke. Instead, it is carefully designed and well positioned to meet the rapid and remarkable technology advance in today's global environment, including US, China and other neighboring countries. In particular, the study and work experience in China offered by the proposed program can closely connect our students to the Chinese industry and explore its local culture. Such experience is highly valuable if students eventually return to China or work for US companies that are heavily engaged in business in China.

2. Program Description

2.1. Strategic Objectives and Education Goals

Our objective of the proposed ECE MEng program is to recruit high-quality students from China and other neighboring countries, and grow them to become technical leaders in the global world. Our fully integrated classroom education and professional training prepare students for active engagement in devising solutions to global technical challenges. It contributes to the global vision of Duke by training these students for global citizenship. In addition, the customized curriculum and training facilitates students to grow their interests and pursue long-term career development in other fields such as business, management, etc.

For Chinese students, the program helps them to make a smooth transition from the conventional Chinese training environment to the US education system that emphasizes technical knowledge, problem-solving skills and industrial practice. This program also offers valuable study and work experience outside the US that cannot be directly acquired by a regular US master program. For international students, they can access to a broader spectrum of Chinese culture and experience, Chinese social network, Chinese internship openings, etc. All of these opportunities are extremely valuable and highly appreciated by today's global society across countries.

2.2. Degree Requirements

Table 1. Schedule and course requirement for the ECE MEng program at DKU

Year 1 @ DKU	Fall	Technical course 1-2
		English and professional training course 1
	Spring	Technical course 3-4
		English and professional training course 2
	Summer	Internship course
		Internship assessment course
Year 2 @ Duke	Fall	Technical courses 5-6
		Industrial preparation course 1
		English and professional training course 3
	Spring	Technical courses 7-8
		Industrial preparation course 2
		English and professional training course 4

The proposed ECE MEng program emphasizes international experience and contexts and trains students to become global technical leaders. Students in the proposed ECE MEng program will gain the required technical knowledge and problem-solving skills to devise innovative solutions to complex problems related to electrical and computer engineering. Our goal is to train students so that they are ready to tackle the industrial R&D tasks in today's global environment. We rely on the current infrastructure and strength of the Pratt School of Engineering and its ECE department. However, we do not simply replicate the current Duke ECE program at DKU.

Instead, our proposed program is carefully designed and well positioned to meet the rapid and remarkable technology advance across multiple countries, including US, China and other neighboring countries.

Our program is composed of 4 semesters, including 16 courses for a total of 30 credits. Among these 16 courses, there are 8 technical courses (3 credits per course), 2 industry preparation courses (3 credits per course), 4 English and professional training courses (0 credit) and 2 internship courses (0 credit), as shown in Table 1. Each student is expected to spend the first year in China and the second year in the US.

During the first year at DKU, students are expected to take 4 technical courses to acquire the technical background in ECE and other related fields. They are also expected to take 2 English and professional training courses to improve their knowledge and skills in language, presentation, writing, communication, academic integrity, social skills, etc. Following two semesters of education at DKU, students will pursue their summer internship in order to gain industrial knowledge and apply learning in service to the global society. Students are free to choose their preferred locations for summer internship. We expect that most Chinese students will complete their summer internship in China and most international students may pursue the summer internship in their home countries. The aforementioned internship experience also facilitates our students to be exposed to the industrial culture, and is extremely valuable and highly appreciated by today's global society. The internship requirement is formally incorporated into the curriculum by two courses, as shown in Table 1.

During the second year, students will spend one academic year (i.e., two successive semesters) at Duke. They will take 4 technical courses to further enhance their technical depth and 2 industrial preparation courses to gain business and management background for engineering and technology. In addition, students will continue to take two English and profession training courses to improve their language and communication skills. The second year of education offers our students with great access to Duke faculty, US culture, US professional network, etc. At the end of the second year, students receive a Duke MEng degree in ECE and have the option to apply for Optional Practical Training (OPT) from the US Citizenship and Immigration Services. Note that students must be registered for full-time status in the US for one academic year in order to be eligible for OPT. Once the OPT is approved, students are allowed to work for US industry to further expand their working experience and industrial knowledge in the US environment.

Because students in the proposed MEng program will receive a Duke degree after graduation, the degree requirement should be exactly identical to that defined for the existing ECE MEng program at Duke Pratt (http://meng.pratt.duke.edu/disciplines/electrical-computer/curriculum-overview). On the other hand, a unique feature of the proposed program is to create global experience and international culture with particular depth in China. We anticipate that the technical courses offered at DKU will have a strong focus on various engineering problems posed by the industry in China and its neighboring countries. For this reason, the proposed program is expected to grow a large number of global technical leaders over

next several decades. In the long term, we anticipate DKU, collaborating with Duke, to initiate, drive and lead the “Eastern Silicon Valley” with high-tech industry in Asia.

2.3. Customized Curriculum

The proposed ECE MEng program offers five concentration areas: (1) micro-nano systems (NS), (2) photonics (PH), (3) computer engineering (CE), (4) sensing and waves (SW), and (5) signal processing and communication (SP). To receive ECE MEng degree at Duke, the aforementioned 8 technical courses must fall into two different categories: (1) 5 courses for departmental/disciplinary or cross disciplinary requirements, and (2) 3 elective courses in a concentration area. Immediately after students start their first year at DKU, each of them should submit a course plan to be approved by both the GSC at DKU and the Managing Director of Graduate Studies at Duke ECE.

Based on the recent analysis by Prof. Drew Hilton who is the Managing Director of Graduate Studies at Duke ECE, most ECE master students are taking courses in two focused areas: (1) computer engineering (about 50%) and (2) signal processing and communication focusing on big data analysis (about 50%). Hence, we will initially focus on CE and SP and offer most courses in these two areas. If our students express strong interests in other areas, we will grow additional concentration areas in the future. Below we outline the basic components of the proposed curriculum.

Technical Courses at DKU

In general, each technical course taught at DKU should involve 150-minute lecture time per week over the entire semester (i.e., 14 weeks). If a course is taught by a visiting faculty from Duke, we will consider to allow 300-minute lecture time per week over 7 weeks. Most technical courses will be taught by full-time faculty at DKU.

Table 2. Technical courses at DKU

Course Number	Course Name	Area	Credits
ECE 550	Fundamentals of Computer Systems and Engineering	CE	3
ECE 551	Programming, Data Structures, and Algorithms in C++	CE	3
ECE 581	Random Signals and Noise	SP	3
ECE 590	Vector Space Methods with Applications	SP	3
NEW	Physical Imaging	SW	3
NEW	Numerical Methods for Scientific Computing and Machine Learning	CE	3
ECE 650	Systems Programming and Engineering	CE	3
ECE 651	Software Engineering	CE	3
ECE 681	Pattern Classification and Recognition Technology	CE	3
NEW	Probabilistic Machine Learning	SP	3
NEW	Computational Photography	PH	3

Industrial Preparation Courses at Duke

The following industrial preparation courses are offered and managed by the Pratt Office of Master Programs at Duke.

Table 3. Industrial preparation courses at Duke

Course Number	Course Name	Credits
MENG 540	Management of High Tech Industries	3
MENG 570	Business Fundamentals for Engineers	3

Technical Courses at Duke

While students are at Duke during their second year, they are exposed to a large number of technical courses. The following is a small sampling list of technical electives offered by the ECE department at Duke.

Table 4. Technical courses at Duke

Course Number	Course Name	Area	Credits
ECE 511	Foundations of Nanoscale Science and Technology	NS	3
ECE 521	Quantum Mechanics	NS	3
ECE 545	Nanophotonics	PH	3
ECE 546	Optoelectronic Devices	PH	3
ECE 553	Compiler Construction	CE	3
ECE 555	Probability for Electrical and Computer Engineers	CE	3
ECE 571	Electromagnetic Theory	SW	3
ECE 574	Waves in Matter	SW	3
ECE 582	Digital Signal Processing	SP	3
ECE 686	Adaptive Filters	SP	3

English and Professional Training

Even though all students of the proposed ECE MEng program must take the regular English exams (e.g., GRE and TOFEL) prior to enrollment, we anticipate that most international students still need additional support and training in language, presentation, writing, communication, etc. Hence, we will contract with the writing program at DKU (similar to the other programs at DKU) to offer 2 English and professional training courses. Students are expected to take one of these courses at each semester during the first year at DKU. The contents of these courses will be jointly discussed, customized and decided by the writing program and the Graduate Study Committee (GSC) at DKU, and approved by Pratt/ECE at Duke. Trained by these courses, students are expected to improve the language background, academic integrity and social skills throughout their studies at DKU. While students are at Duke during the second year, they will continue to take 2 English and professional training courses (one course for each semester). These two courses will be offered and managed by the Pratt Office of Master Programs at Duke.

Summer Internship

Following two semesters of education at DKU, students should pursue their summer internship in order to gain industrial knowledge while serving the global society. iAPSE will actively engage with major companies (e.g., Microsoft, Google, IBM, Alibaba, Baidu, Intel, GM, etc.) to build strategic partnership. These industrial companies carry leading-edge technologies in the ECE field and can provide excellent opportunities for summer internship where students are expected to access the state-of-the-art technologies, complementary to the traditional classroom education. Students are free to choose their preferred locations for summer internship. We expect that most Chinese students will complete their summer internship in China and most international students may pursue the summer internship in their home countries. During the internship, students may interact with their global colleagues for day-to-day operations. It, in turn, offers an intercultural opportunity for communication, collaboration and training.

To further support the summer internship program, technical courses taught at DKU will be aligned with industrial needs to well prepare our students so that they can be quickly adapted to the working environment and make substantial progress at industry. The aforementioned internship program also provides industrial companies an excellent channel for talent training and recruitment and, hence, should be highly appreciated by the industrial partners.

Students must register for MENG 550 (Internship) and MENG 551 (Internship Assessment) when fulfilling the internship requirements. Both of these two courses carry 0 credits. However, they offer a formal mechanism to administrate the internship requirement and assess its outcome.

2.4. Course Descriptions and Learning Opportunities

Detailed course descriptions can be found in Section 9.1. Note that the scope, dimension, and character of the curriculum remain a provisional scaffolding, as many details of the particular core courses and electives will depend not only on the faculty to be hired, but also on what they learn through their own teaching experience integrated with the international culture at DKU. As the program grows, an increasingly number of faculty members will be recruited at DKU to offer extra courses.

2.5. Faculty Resources

To implement the proposed education and research plan, we have budgeted 4.5 full-time faculty members and 1 visiting faculty member at DKU. To build a collaborative and multidisciplinary program with global reputation, we will internationally recruit the full-time faculty members from premier universities.

Table 5 summarizes the teaching assignment for all faculty members at DKU. In total, we are able to offer 10 technical courses at DKU to cover both breadth and depth. To offer diversified courses, we plan to share teaching resources with the undergraduate program at DKU. Our faculty members from the proposed ECE MEng program are expected to teach the undergraduate students (e.g., for the data science major) at DKU. In this way, we will be able to

recruit more than 4.5 faculty members over a broad range of technical areas with 4.5 FTEs. In addition, we will contract with the writing program at DKU (similar to the other programs at DKU) to offer 2 English and profession training courses. At the end of the summer internship, all faculty members will work together to assess the internship outcome for all students.

After the proposed MEng program is approved by Duke faculty, the Duke and DKU Boards, SACS and the Chinese Ministry of Education (MOE), we will start faculty recruitment at DKU. Prof. Xin Li is already at DKU now. He is expected to play a critical role to establish new education initiatives and attract other junior faculty to DKU. Recently, Prof. Ming Li has been recruited from the Joint Engineering Institute of Carnegie Mellon University and Sun Yat-sen University and will join DKU in March 2018. He is an expert in speech recognition and natural language processing and has featured by the Science magazine as a rising start in academia. Both Prof. Xin Li and Prof. Ming Li are expected to teach for the proposed ECE MEng program, once the program is established.

More recently, we have been actively recruiting Prof. Mei Chen, from The State University of New York at Albany. Prof. Chen received her PhD from Carnegie Mellon University in 1999 and is an internationally renowned expert in computer vision. She has extensive experience with major industrial companies including Intel, HP and SRI and is now an associate professor at The State University of New York. Taking Prof. Chen as an example, we will make all efforts to recruit female and minority faculty members to build the diversity for our proposed ECE MEng program.

Table 5. Teaching assignment for the ECE MEng program at DKU

Fall	Full-time faculty 1	Technical course 1
	Full-time faculty 2	Technical course 2
	Full-time faculty 3	Technical course 3
	Full-time faculty 4	Technical course 4
	Full-time faculty 5 (50%)	Technical course 5
	Writing program at DKU	English and professional training course 1
Spring	Full-time faculty 1	Technical courses 6
	Full-time faculty 2	Technical courses 7
	Full-time faculty 3	Technical courses 8
	Full-time faculty 4	Technical courses 9
	Visiting faculty	Technical courses 10
	Writing program at DKU	English and professional training course 2
Summer	All faculty	Internship assessment course

In addition to full-time DKU faculty, our budget further includes funding for 1 visiting faculty from Duke to participate in the proposed MEng program at DKU. There are enormous opportunities for international education, interdisciplinary research, culture development and technology transfer in China that are highly attractive to Duke faculty. DKU offers extensive infrastructures (e.g., industrial connection, local staff, conference center, etc.) for Duke visiting faculty to easily access and explore the unique opportunities in China. A number of Duke faculty

members, including Prof. David Brady (ECE) and Prof. Jian-Guo Liu (Mathematics/Physics), have already been actively engaged with DKU over the past several years. Any Duke faculty visiting DKU for one semester needs approval of departmental chairs or deans to ensure that their courses and advising loads at Duke are fully covered.

To offer the English and professional training courses at DKU, 2 language instructors will be recruited by the writing program at DKU and paid by the proposed ECE MEng program. Since our ECE program does not have the expertise to evaluate professional language instructors, we will contract with the writing program to offer English and professional training service.

In addition to Prof. Xin Li (50% appointment at Duke), 4 full-time faculty members will be recruited by the ECE department at Duke, including both tenure-track and teaching faculty members. When 100 students come to Duke and each of them takes 4 technical courses during their second year, at least 10 sessions should be added at Duke, assuming less than 40 students in each session. If there are 2.5 tenure-track faculty members and 2 teaching faculty members, we will be able to cover 13 sessions each year and, hence, provide sufficient faculty resources to teach these 100 students. The exact number of tenure-track slots is not determined by the proposed MEng program and must be decided by the Dean of Pratt.

The master students at Duke ECE typically take about 10~20% courses from other departments, including Computer Science, Statistics, Mathematics, etc. As the number of students grows for the proposed MEng program, we plan to coordinate with these departments to discuss possible solutions to address the increased teaching demands so that they are not overloaded by our ECE students. In particular, the following three courses are most popular for ECE master students: Probabilistic Machine Learning (STA 561), Introduction to Algorithms (CS 531), and Computer Networks and Distributed Systems (CS 514). Among these three courses, Probabilistic Machine Learning is taught by Prof. Cynthia Rudin who is a faculty member in both Computer Science (50%) and Electrical and Computer Engineering (50%).

Furthermore, 1.5 instructors will be recruited to teach two industrial preparation courses and 2 language instructors will be recruited to teach the two English and professional training courses at Duke. The Pratt Office of Master Programs will coordinate with Fuqua and Graduate School to identify these instructors, by following the current practice of existing MEng programs at Duke.

The proposed ECE MEng program is scheduled to launch in Fall 2019. Table 6 and Table 7 summarize the numbers of expected students and recruited faculty as the program grows over years. When the program is initially developed in Fall 2019, we anticipate enrolling 25 students and recruiting 1.5 full-time faculty members at DKU. In Fall 2020, these 25 students will arrive at Duke and, hence, 2 full-time faculty member should be recruited at Duke. Other than the DKU faculty members, we expect that 1 visiting faculty members from Duke will visit DKU and he/she will teach one course at DKU. Given these faculty resources, we are ready to offer 4 technical courses at DKU during the academic year 2019/2020. As the program grows, an increasing number of full-time faculty members will be recruited at both DKU and Duke, as shown in Table 6 and Table 7. Consequently, we will be able to offer additional courses for our

students.

Table 6. Student enrollment and faculty recruitment for the ECE MEng program at DKU

Year	Number of Students	Number of ECE Faculty	Number of Language Instructors
2019/2020	25	1.5	0.5
2020/2021	40	1.5	1
2021/2022	65	2.5	1.5
2022/2023	90	3.5	2
2023/2024	100	4.5	2
2024/2025	100	4.5	2
2025/2026+	100	4.5	2

Table 7. Student enrollment and faculty recruitment for the ECE MEng program at Duke

Year	Number of Students	Number of ECE Faculty	Number of Language Instructors	Number of Instructors for Industrial Courses
2019/2020	0	0	0	0
2020/2021	25	2	0.5	0.5
2021/2022	40	2.5	1	1
2022/2023	65	3	1.5	1.5
2023/2024	90	3.5	2	1.5
2024/2025	100	4.5	2	1.5
2025/2026+	100	4.5	2	1.5

2.6. Staff Resources

In addition to the aforementioned faculty positions, we expect to recruit 3 staff members (2.5 FTEs with 2 full-time staff members and 1 part-time staff members) at DKU to support the proposed ECE MEng program, as summarized in Table 8. The part-time Admin Assistant will be shared with other education programs or research centers at DKU.

Table 8. Staff recruitment for the ECE MEng program

Title	FTE	Location	Starting Date
Marketing and Recruitment Manager	1	DKU	Summer 2018
Program Coordinator	1	DKU	Summer 2019
Admin Assistant	0.5	DKU	Summer 2019
Program Coordinator	1	Duke	Summer 2020
Career Advisor	1	Duke	Summer 2020
Lab Facility Manager	0.5	Duke	Summer 2020

At Duke, a Program Coordinator will be recruited in order to communicate with the faculty and staff and take into account the culture and requirements at Duke. The Program Coordinator at Duke will also work closely with the faculty and staff at DKU for student recruitment,

admission and management. Because most students in our proposed ECE MEng program will look for a job in the US after graduation, a Career Advisor will be recruited at Duke for career counseling, industrial networking, resume preparing, etc. Finally, a part-time Lab Facility Manager will be recruited and shared with the regular ECE programs at Duke.

2.7. Target Students

Our proposed program will internationally recruit and educate top talent to implement the global vision for Duke and DKU. We anticipate the student body for this population would be: (1) recent Chinese undergraduates, (2) industrial engineers in China who want to come back to school for advanced degree, (3) undergraduate students from broader Asia who want to stay closer to home and gain a more regional perspective, and (4) US/European students who want to attend a foreign program within China.

Unlike other conventional US programs, we expect that a significant portion of our students plan to return China eventually. As shown by the market survey in Section 4, about 57% of today's Chinese students fall into this category. The internship and networking opportunities offered by our proposed MEng program are highly attractive to these students. As more and more students are enrolled in our program, we will have the opportunity to fully understand their needs and, consequently, further tune our program setup to serve these students.

China owns a large population of engineering students. The total number of undergraduate enrollment is around 21-22M for both US and China. However, only 10% of students choose engineering majors in the US, while the percentage of engineering students reaches 35% in China. A recent report by Chinese government claims that about 0.5M Chinese students leave China to study aboard every year and about one third of these students are in engineering majors.

As a reference point, the ECE department at Carnegie Mellon University has 483 master students in Fall 2016, including 422 international students and 61 US students. More than two thirds of the international students come from China. Based on these data, we anticipate that a large portion of the students enrolled in our proposed ECE MEng program will be from China.

3. Relationship with Other Programs

3.1. Features

Compared to other programs at Duke and other universities, the proposed ECE MEng program offers a number of unique features:

- *Customized curriculum*: The proposed MEng program offers a series of courses covering engineering, business and management. Different from the conventional MS program, our MEng program particularly allows students to take two industrial preparation classes covering industrial management and business fundamentals. The curriculum arms our students with broad knowledge background. It is a key characteristic for future technical leaders who can easily navigate among multiple domains for both technology and business development. From this point of view, we anticipate that the MEng program is more attractive than the MS program if a student plans to take a technical management and leadership position in the future.

- *Training on problem-solving skills*: Most master programs in China focus on basic concepts and scientific theorems, where students are expected to work out homework assignments and exams only. We strongly emphasize technical training on problem-solving skills. Our technical courses involve multiple projects derived from practical applications. After such an intensive training, students are ready to tackle industrial R&D tasks immediately after their graduation.
- *High-quality education*: Guided by the strategic vision of iAPSE, high-quality full-time faculty members will be recruited by DKU at the US pay scale. These faculty members are expected to have PhD degrees from world-class universities. In addition, they are expected to visit Duke to learn the philosophies and methodologies for education and research that are different from the conventional education system in China. Based upon these DKU faculty members, along with visiting faculty members from Duke, we expect to offer a premium education service to our students at DKU.
- *Duke degree*: The degree issued for the proposed MEng program will be identical to that for the existing ECE MEng program at Duke Pratt. Because DKU is still a new university, has not had time to establish its own reputation, and needs to compete with other US and Chinese programs, the proposed ECE MEng program will be credentialed by Duke. Moreover, by giving a Duke degree, we are not constrained by the Chinese Ministry of Education (MOE) in terms of student enrollment, degree title, curriculum design, etc. The transcript for the courses taught at DKU will list different course numbers. For instance, ECE 551 (Programming, Data Structures, and Algorithms in C++) will be listed as ECE 551K at DKU. Note that all other DKU graduate programs currently follow the same setup.
- *Access to Duke*: In order to compete with other US programs or China-US joint programs, we allow the DKU students in this program to spend one academic year (i.e., two successive semesters) at Duke. It provides these students with great access to Duke faculty, US culture, US professional network, etc. Meanwhile, the students would bring their international experience and share it with the faculty, staff and students in Durham, turning Duke into a truly international campus. In addition, we also plan to arrange Duke faculty to visit DKU and teach technical courses there. The visiting faculty program would effectively connect Duke to DKU for extensive international collaboration.
- *Customized education plan for non-US students*: Most non-US students (particularly, Chinese students) are trained by a different education system with different language, curriculum, culture, etc., before they come to US. When they move from their home countries to US, they experience culture "shock" due to substantial changes in language, curriculum, social environment, etc. The proposed ECE MEng program allows these students to stay in China for the first year where they receive US-style education in their home zone. In addition, DKU offers two English and profession training courses during the first year that cover language, presentation, writing, communication, academic integrity, social skills, etc. These setups uniquely owned by our proposed ECE MEng program play a critical role to help non-US students to make a smooth transition to US.
- *Networking and internship opportunities*: iAPSE will take advantage of its broad network of

industrial member companies to organize social events for students to explore and understand the industrial environment. iAPSE will also bridge students to appropriate technical positions based on their interests and background for summer internship, allowing students to gain industrial knowledge and apply learning in service to the global society. These activities facilitate students to experience the industrial culture in China or other neighboring countries, which cannot be directly acquired by other master programs in either China or US. Such experience is extremely valuable if a student plans to work in China or Asia immediately or a few years after his/her graduation. It is also highly appreciated by today's global society across countries.

- *Access to US job market*: Students graduated from the proposed MEng program are eligible for Optional Practical Training (OPT). It allows them to work for US industry to further expand their working experience and industrial knowledge in the US environment, even though many Chinese students may choose to return to China after working in US for a few years.

3.2. Competitiveness

The proposed ECE MEng program is compared against three different categories of programs to demonstrate its competitiveness: (1) master programs by Chinese universities in China, (2) joint master programs by US/European/Chinese universities in China, and (3) master programs by US universities in the US.

Master programs by Chinese Universities in China

Most Chinese universities offer master programs in ECE today. These Chinese programs train students on basic concepts and scientific theorems only. Students are required to work out homework assignments and exams without being exposed to problems and projects derived from practical applications. Their students cannot easily access the US-style education where professional training, problem-solving skills and industrial practice are strongly emphasized. Consequently, students trained by these programs are not immediately ready to serve for industrial research and development after graduation.

Joint Master Programs by US/European/Chinese Universities in China

Table 9. Joint master programs by US/European/Chinese universities in China

Master Program	Duration	Tuition per Year	US Degree?	Weakness
STJU-UMich	2.5-year	$7,462	No	Do not offer US degree, and students cannot study or work in the US.
Nottingham Ningbo	1.5-year	$11,940	No	
XJTU-Liverpool	1.5-year	$13,432	No	
CUHK Shenzhen	2-year	$14,179	No	

Our main competition comes from other joint master programs offered by US/European/Chinese universities in China, as shown in Table 9. These programs charge relatively inexpensive tuition without offering a US degree. Hence, even though students may

enjoy western-style education philosophies and methodologies, they cannot study or work in the US by enrolling in these programs.

In addition to these master programs, Zhejiang University and University of Illinois at Urbana-Champaign recently developed a joint engineering program in China. It currently recruits undergraduate students only and, therefore, does not directly compete with our proposed ECE MEng program.

Master programs by US Universities in the US

The conventional US master programs often offer attractive education experience to students; however, they are not necessarily customized for international students. When most international students move from their home countries to US, they experience culture "shock" due to substantial changes in language, curriculum, social environment, etc. In addition, the conventional US master programs are not specifically designed to offer the international education experience for those students who plan to work for multinational companies heavily engaged in business in China.

Even though the proposed MEng program offers these key features that distinguish itself from other master programs, its cost of attendance is even lower than the conventional master programs in US. Table 10 compares the tuition and fees for the ECE MEng program at Duke and DKU. The comparison assumes that students in the Duke program only take one class and, hence, pay one third of the tuition in the fourth semester. Overall, the education cost is reduced by 15%, because students from the DKU program pay less tuition and living expenses for their first year in China.

Table 10. Tuition and fees for the ECE MEng program at DKU and Duke

		Duke Program	DKU Program
Year 1	Tuition	$49,560	$25,714
	Room	$8,658	$2,400
	Board	$4,644	$2,762
	Health insurance	$3,767	$2,338
	Book	$1,240	$1,178
	Transportation, misc.	$5,166	$2,922
Year 2	Tuition	$33,040	$49,560
	Room	$8,658	$8,658
	Board	$4,644	$4,644
	Health insurance	$3,767	$3,767
	Book	$1,240	$1,240
	Transportation, misc.	$5,166	$5,166
Total		$129,550	$110,349

Based on the aforementioned discussions, our proposed ECE MEng program at DKU is highly competitive over the master programs offered by other universities. Therefore, with appropriate marketing and recruitment, we are confident to attract a large number of top

engineering students from China and other neighboring countries.

3.3. Collaboration with Duke ECE

By leveraging the strength of education and research at DKU, the proposed program will closely collaborate with the ECE program at Duke. We anticipate that the engagement with DKU will add a more expansive global component to the current infrastructure of student recruitment and training, resource sharing, technology transfer, etc. at the ECE Department at Duke, which should enhance Duke's international leadership in the global ECE community.

The ECE department at Duke plans to substantially grow the number of master students over the next few years. The planned growth is driven by a strong need on the part of many organizations and companies to recruit a large number of engineers in this emerging field. Pratt is taking its position to train high-quality engineers to serve this societal need. Based on the recent analysis by Prof. Drew Hilton who is the Managing Director of Graduate Studies at Duke ECE, most ECE master students are taking courses in two focused areas: (1) computer engineering (about 50%) and (2) signal processing and communication focusing on big data analysis (about 50%).

When growing the student population, Pratt plans to recruit future students from groups with the potential for growth based on technical background, career goals, etc. As shown by the market survey in Section 4, most of our DKU MEng students are expected to be Chinese and they plan to return China eventually, while most students in the existing ECE master program want to stay in the US in long term. It is acknowledged that this cohort of students will be predominantly from China and therefore will expand the representation of Chinese in the student body within ECE at Pratt, but we also note that this demographic segment will primarily affect the diversity of the second year of students, with the diversity of the first-year students at Pratt largely unchanged. However, we see this program in collaboration with DKU as an opportunity to reach a segment of potential students (those desiring to return in long term for employment in China) that would not have been previously reached. As indicated by the support letters from Prof. Ravi Bellamkonda (Dean of Pratt) and Prof. Krishnendu Chakrabarty (Chair of ECE), both Pratt and ECE are fully committed to provide the resources to gradually grow the student population over the following years.

4. Market Research

Two separate market surveys were performed to understand the market needs for the proposed ECE MEng program. The first market survey was conducted by Nielsen Greater China for students and parents. The second market survey was conducted by Prof. Xin Li where he contacted 7 international companies by email to understand the perspectives of these industrial employers.

4.1. Survey for Students and Parents

The market survey is composed of two major components: (1) a qualitative study with 40 in-

depth interviews for parents and students in 5 major Chinese cities, and (2) a quantitative study with 400 online surveys for students and their parents in engineering or applied sciences who will apply for master programs in 6-24 months. The survey leads to several key observations.

Student Groups

There are three groups of students that have been identified during the market survey:

- *Group 1: journey focused students with plans to come back to china (about 37%)*: These students are most likely to apply for our proposed MEng program and accept the offer. They want to experience foreign culture and consider the Duke degree as an attractive feature for our program.
- *Group 2: goal focused students with plans to come back to china (about 20%)*: These students have great potential to apply. They want to receive technical and language training within the US education system. They highly value the internship and networking opportunities offered by the proposed MEng program.
- *Group 3: goal focused students with plans to stay in the US (about 40%)*: These students are least likely to apply for our proposed program. They want to take the best technical program in ECE in order to become the best engineers in the field. Most of them will pursue the top-ranked US universities in ECE such as MIT, Standard, Berkeley, CMU, etc.

Based on these observations, we should target the students in Group 1 and 2 for marketing and recruitment. Even though these students will return China eventually, they value the experience in US and want to work in US for several years after graduation. Hence, the access to US job market offered by the proposed MEng program is an attractive feature to them.

Student Population

Among all students who are interested in studying aboard, 57% of them view positively about the ECE MEng program at DKU, because these students plan to come back to China in either short term or long term. About 31% of students show strong interests in applying for the ECE MEng program and about 37% of parents would like to ask their children to apply for the ECE MEng program.

Based on a report prepared by the Council of Graduate Schools (http://cgsnet.org/ckfinder/userfiles/files/CGS_GED16_Report_Final.pdf), the total number of master students with engineering major is 36,375 for US universities in 2016. A large portion of these students take the ECE major and are from China. Hence, we believe that there is a large market in China.

The market research can estimate the market size. However, it cannot precisely predict the number of students who will accept our offer, without knowing the detailed recruitment efforts by other competitive universities. We need to develop a competitive program to attract high-quality students. Otherwise, a large number of students may not choose our program and will join other universities in US.

Female Students

Gender balance is an important consideration when recruiting students in fields of engineering, and we aim for a student body with good balance between genders. The market survey data indicates that female students have shown strong interest in the proposed ECE MEng program. During student recruitment, we will identify considerations of importance to female students in order to attract them to our proposed program, and eventually build a diversified ECE MEng program.

4.2. Survey for Industrial Employers

Table 11. Outcome summary of employer survey

Company	MS vs. MEng?	Duke vs. DKU?	China Experience?
Google	Both	Duke (well established)	Equally important as US
IBM	MS	Both	Important
Huawei (US)	MEng	Both	Important
Boeing	MEng	Both	Important
Dell	Both	Both	Important for operation in China
Facebook	MS	Duke (well established)	Not important
Intel	Both	Both	Important

A questionnaire was sent to the management personnel of 7 international companies. The full questionnaire and replies can be found in Section 9.7. Table 11 summarizes the outcome of the survey from which two important observations can be made:

- MS and MEng are considered to be equally important.
- Most companies believe that the studying and working experience in China is highly valuable.

Most Chinese students at Duke ECE currently prefer to take the MS program over the MEng program, because MEng programs are not popular in China today. However, we want to propose an MEng program, instead of an MS program, at DKU, because the Chinese Ministry of Education (MOE) is gradually converting MS programs to MEng programs in Chinese Universities now. In P. R. China, MS students are required to work on research projects. The Chinese MOE plans to remove the research component from master programs, downsize the MS programs, and only requires PhD students to work on academic research. Given this recent trend in China, we expect that an MEng program will become more competitive than an MS program in China in the near future.

In addition to the aforementioned two surveys, Prof. Xin Li has been communicating with a number of industrial companies about possible collaboration (e.g., summer internship, job fair, etc.) for the proposed ECE MEng program. 7 companies (including Dell, Cadence, etc.) would like to move forward to sign a memorandum of understanding (MOU) with DKU in order to aggressively recruit our students.

The facts listed in this section strongly demonstrate that a large amount of students are available on the market to meet our enrolment target and industrial employers have shown great interests to collaborate with us for student recruitment.

5. Financial Projections

A detailed budget plan is attached, including three financial documents: (1) budget for the baseline scenario, (2) budget for the worst-case scenario, and (3) summary for the cost of attendance. The budget plan has been developed by the Provost's Office in consultation with the Executive Vice Provost for Finance and Administration, taking into account the data supplied by Pratt, ECE and DKU.

DKU will assume all financial risk for the program offered at DKU. We want to emphasize that the recruitment of faculty and staff for the proposed ECE MEng program is not significantly larger than other comparable programs at DKU. Our proposed faculty and staff numbers are in line with the Global Health Program and the Environmental Policy Program at DKU.

All DKU programs must have a positive contribution margin to help pay for the indirect costs of operating programs at DKU, including campus leadership, HR, finance, IT, administration, and operating costs of campus facilities and grounds. Immediately after the proposed ECE MEng program is launched, it will recruit 25 students and have a positive contribution margin of $7.75K. In 2023/2024, when the program reaches the targeted capacity of 100 students per year, it will lead to a positive contribution margin of $1.07M.

At Duke, the proposed ECE MEng program will have a positive contribution margin of $0.633M for Duke in 2020/2021, when we successfully recruit 25 students. With 100 students per year in 2024/2025, the MEng program will lead to a positive contribution margin of $2.483M for Duke.

If we cannot attract a sufficient number of high-quality students, the proposed ECE MEng program will not be viable. However, we do not believe that the situation will happen, because China has a large population of engineering students and these students are enthusiastic about earning a graduate degree from a US university. In addition, the proposed MEng program is specifically designed to offer the international education experience for those students who plan to work for multinational companies heavily engaged in business in China.

We do not anticipate taking significant efforts from existing Duke faculty or staff for marketing, recruiting, admissions, career services, etc. The budget ensures that both Duke and DKU will recruit new faculty and staff members responsible for these tasks. Conversely, the fact that DKU offers dedicated staff members to advertise and promote the ECE programs for both Duke and DKU would boost the academic reputation and establish the global leadership for both campuses. We anticipate that such marketing and recruitment activities will soon increase the application pools and attract high-quality students for both Duke and DKU.

5.1. Budget Details for Baseline Scenario

Tuition

The tuition is set to ¥180,000 (equivalently $25,714 by using the current exchange rate) per year for Chinese students and $49,560 per year for non-Chinese students. The tuition for Chinese students is regulated by the Chines government. Since non-Chinese students pay much higher tuition, significant financial aid will be provided to these students to offset the cost.

When students come to Duke during the second year, DKU will pay Duke the service fee that is equivalent to the net tuition of the second year to host these students. In addition, Duke will charge additional program fee for each student. The program fee is equal to the difference between the Duke tuition and DKU tuition. It will be calculated every year, as the tuition and exchange rate vary. Pratt/ECE at Duke will use these funds to recruit new faculty/staff and prepare for other required resources to support the program.

Aiming at a conservative estimation of tuition income, we assume that most students are from China and, hence, pay the reduced tuition. When the program reaches the targeted size of 100 students per year in 2024/2025, the net tuition is around $2.317M and $2.184M for DKU and Duke respectively. With the extra program fee of $2.269M, Duke is expected to receive the revenue of $4.454M annually.

Financial Aid

We assume 10% financial aid for Chinese and 50% for non-Chinese. The funds come from the tuition paid by students. Both academic quality and financial need will be taken into account when distrusting the financial aid among students. Students with excellent academic record or strong financial need are expected to receive significant financial support from the university.

We will consider diversity as an important metric when distributing financial aid. Female, minority and international students will be considered with high priority for financial support in order to attract them and, consequently, increase the diversity of the proposed ECE MEng program.

Additional funds will be available from individual donation and/or industrial support. Prof. Xin Li has contacted several industrial companies (including Dell, Cadence, etc.) and these companies are willing to financially support our students by a variety of channels. For instance, Cadence is willing to offer a full or partial scholarship to a high-quality student who would like to join Cadence as a full-time employee after graduation.

Faculty/Staff Compensation, Benefits and Allowances

The budget covers 4.5 faculty members (4.5 FTEs), 3 staff members (2.5 FTEs with 2 full-time staff members and 1 part-time staff members), 2 language instructors (2 FTEs) and 4 teaching assistants (4 FTEs) at DKU, as shown in Table 6 on Page 17 and Table 8 on Page 17. Each full-time faculty will be paid for $110,000-130,000 per year. We will also pay 1 course buyout for a Duke visiting faculty each year where the cost for one course is $15,000-50,000. The budget for compensation and benefits is about $0.807M per year at DKU. Faculty at DKU, including the Program Director, will be offered with allowances for start-up support, travel, relocation, housing, etc. When the program reaches its steady state, the total cost of allowances is

around $0.185M per year at DKU.

Based upon the tuition income generated by the program, Duke will recruit 4.5 faculty members (4.5 FTEs), 3 staff members (2.5 FTEs with 2 full-time staff members and 1 part-time staff member), 1.5 instructors for industrial preparation courses (1.5 FTEs) and 2 language instructors (2 FTEs), as shown in Table 7 on Page 17 and Table 8 on Page 17. These recruitments will follow the regular guidelines for salary and compensations. At Pratt/ECE, each full-time faculty will be paid for $105,000-180,000 per year. Faculty at Duke, including the Program Director, will be offered with allowances for start-up support and relocation. In addition, Pratt will coordinate with Fuqua and Graduate School to recruit 1.5 industrial course instructors and 2 language instructors respectively, by following the current practice of existing MEng programs at Duke. The annual costs for industrial preparation courses and English and professional training courses are $150,000 and $241,383 respectively, when the number of students reaches 100 in 2024/2025.

Other Operating Expenses

The operating expenses include travel, server and software, instructional costs, marketing and recruiting, etc.

Contribution Margin

The total income minus all expenses becomes positive in 2019/2020 for DKU immediately after the program is launched. At that moment, the net tuition exceeds all expenses by about $7.76K. The contribution margin is $0.633M for Duke in 2020/2021, when we successfully recruit 25 students. When the program reaches its targeted capacity of 100 students per year in 2024/2025, the contribution margin is expected to be $1.07M for DKU and $2.483M for Duke respectively. The greatest financial risk is failing to meet the enrollment targets and/or requiring higher amounts of financial aid to attract students. A contingency plan for the worst-case scenario will be further discussed in Section 5.2.

5.2. Contingency Plan for Worst-Case Scenario

In addition to our baseline budget scenario, we now present a worst-case scenario with lagged and reduced enrollment. In this scenario, we miss our initial enrollment target of 25 students for the first year and it takes five years to reach the enrollment of 50 students per year. The worst-case budget shows that the proposed ECE MEng program will have a positive contribution margin of $0.309M for DKU and $1.106M for Duke respectively, once the enrollment reaches 50 students in 2025/2026.

If our enrollment lags the projected numbers given by the baseline scenario, we will take carefully planned actions to compensate in other areas. The Program Director, working with the PMC, has several options:

- *Faculty recruitment*: Instead of recruiting 4.5 full-time faculty members for 100 students, we plan to recruit 2.5 full-time faculty members if the enrollment reaches 50 students only. In

addition, the starting date of these faculty members will be delayed by 1-2 years until the enrollment number grows and, hence, new faculty is needed. Similarly, the numbers of instructors for both the industrial preparation courses and the English and profession training courses will be reduced.

- *Staff recruitment*: The required efforts should be reduced for staff support at both DKU and Duke in the worst-case scenario. Meanwhile, the required number of teaching assistants should be reduced too.

The combination of these options will reduce the operating cost and, consequently, maintain a positive contribution margin of $0.309M for DKU and $1.106M for Duke respectively, after the program reaches its steady state. The expected enrollment number should become clearer in January 2019, after all applications have been received. At that point, we will decide the exact plan for resource allocation based on the enrollment number. The aforementioned scenario represents the worst case and the actual scenario is expected to sit between our baseline and the worst case.

5.3. Other Resources at DKU

Teaching Assistants

To offer the proposed technical courses at DKU with highest quality, 4 full-time teaching assistants (4 FTEs) have been budgeted and will be recruited in China. They are expected to work with the course instructors to help on labs, grading, office hours, etc. We will offer a competitive payment to these teaching assistants in order to recruit high-quality candidates. Table 12 summarizes the number of full-time teaching assistants, as the program grows from 15 students to 100 students.

Table 12. Student enrollment and teaching assistant recruitment for the ECE MEng program at DKU

Year	Number of Students	Number of Full-time TAs
2019/2020	25	1
2020/2021	40	2
2021/2022	65	3
2022/2023	90	4
2023/2024	100	4
2024/2025+	100	4

In addition to these full-time teaching assistants, we welcome Duke PhD students to spend one semester at DKU and serve as teaching assistants. Especially when a Duke faculty member (e.g., Prof. Xin Li and Prof. David Brady) stays at DKU, his/her PhD students may come to DKU to closely work with their advisor. These PhD students will serve the TA role to fulfill their academic requirement and will be financially supported by the research grants from their PhD advisors.

Space

Space has been allocated on the second floor of the planned Innovation Building at DKU. In this building, there will be faculty offices, classrooms, labs, and cubicles for students. It will be ready for use in Spring 2019. New faculty members recruited into the program may set up their temporary offices in the Conference Center before the Innovation Building is ready. When the first batch of our students arrives in Fall 2019, the Innovation Building should be available. The Innovation Building is also required to host additional undergraduate students who will join DKU in Fall 2019. In case the Innovation Building is not ready, the contingency plan is for DKU to rent off-campus space for labs, offices, etc.

In the long term, as the proposed ECE MEng program grows, addition space may be needed. DKU is planning to build a new 4-floor building for the Wuhan-Duke Research Institute, starting from 2019. Once this building is available, it will offer extra space for faculty, staff and students.

Computing Infrastructures

A high-end computer server has been budgeted for course offering where students may connect to the server to work on homework assignments and course projects. We have also budgeted the licensing fees for software packages that are popularly used by engineering students. High-speed internet and VPN connection to Duke is also available.

Library Resources

Most technical publications, including books, journals, conference proceedings, etc., are in electronic forms today. When students are at DKU during their first year, they can remotely access about 100,000 e-journal titles, over 1000 databases of scholarly materials, and approximately 1,400,000 electronic books from Duke University Libraries. If any text is not available online, they can request a soft copy (i.e., PDF file) of scanned journal articles or book chapters by using the Document Delivery Service offered by Duke University Libraries. For textbooks required by the courses taught at DKU, we will coordinate with the instructors in advance in order to guarantee to have a hardcopy of each required textbook at the DKU library.

5.4. Other Resources at Duke

When students come to Duke during their second year, we anticipate that resources are required at Duke to support these students. Meanwhile, Duke will be paid to host these students for their second year. Since we plan to gradually grow the student number from 25 to 100 over 5 years, we should have ample time to create the resources and infrastructures required by the proposed ECE MEng program.

Teaching Assistants

Table 13. Student enrollment and teaching assistant recruitment for the ECE MEng program at Duke

Year	Number of Students	Number of PhD TAs
2019/2020	0	0
2020/2021	25	8
2021/2022	40	12
2022/2023	65	20
2023/2024	90	27
2024/2025	100	30
2025/2026+	100	30

Each PhD student is required to serve as two teaching assistants to fulfill his/her academic requirement at Duke ECE. When 100 students come to Duke during their second year, each student is expected to take 4 technical courses. The 4 technical courses require 10 large sessions (40 students per session). Depending on the course load, we need 2~4 PhD TAs per session. Note that 4 PhD TAs are required for a course with heavy course projects (e.g., ECE 550). Hence, 30 PhD TAs are needed to serve these 10 sessions. In case a PhD student serves as a teaching assistant outside his/her academic requirement, he/she will be financially compensated and the cost has already been budgeted in the current financial model. Table 13 summarizes the number of PhD TAs, as the program grows from 15 students to 100 students.

Space

When 100 students come to Duke during their second year, each student is expected to take 4 technical course, 2 industrial preparation course (MEng 540 and MEng 570) and 2 English and professional training courses. The 4 technical courses require 10 large sessions (40 students per session). MEng 540 and MEng 570 require 2 large sessions (50 students per session) and 4 small sessions (25 students per session) respectively. The 2 English and professional training courses require 14 small sessions (15 students per session). Hence, there are 12 large sessions and 18 small sessions in total over one academic year. Equivalently, we will need 6 large sessions and 9 small sessions per semester. A typical classroom accommodates 10 sessions. Hence, we will need about 0.6 large classroom and 0.9 small classroom to host 100 students. Table 14 summarizes the classroom requirement as the program grows from 25 students to 100 students.

Table 14. Student enrollment and classroom requirement for the ECE MEng program

Year	Number of Students	Number of Small Classrooms (25 students) at Duke	Number of Large Classrooms (50 students) at Duke
2019/2020	0	0	0
2020/2021	25	0.5	0
2021/2022	40	0.4	0.3
2022/2023	65	0.7	0.4
2023/2024	90	0.8	0.6
2024/2025	100	0.9	0.6
2025/2026+	100	0.9	0.6

Pratt is committed to provide classrooms and other required spaces for the proposed ECE MEng program. There is a new engineering building that is currently under construction at Duke. It is expected to be ready for use in 2019, before the first batch of our students arrives at Duke in Fall 2020. The new engineering building will be able to provide sufficient spaces when the number of students is small during the first several years. In case the new engineering building is delayed, only one classroom is needed for Fall 2020 and Spring 2021 to host 25 students and we will work with Pratt and ECE to find an available classroom or large conference room on campus. As the program grows, we will actively work with the leadership team at Pratt to secure additional spaces.

Library Resources

When students come to Duke at the second year, they can physically access Duke University Libraries (DUL) at Durham. The library has over 60,000 engineering books and about 30,000 computer science related books. DUL holds the complete Synthesis Digital Library of Engineering and Computer Science collection, the SPIE eBook collection for 2008-present, all of the IEEE Wiley and MIT eBooks, and the Science Direct Computer Science collection. DUL subscribes to a wealth of databases with special relevance to ECE, including IEEE Xplore, SPIE Digital Library, Engineering Village and ACM Digital Library, and offers access to major scientific literature databases, including Web of Science and Scopus.

By discussing with the VP of Library Affairs, we are aware of the limited resources for library services. DUL currently has a single librarian to support students in Pratt. As the proposed MEng program grows, we will work with the VP of Library Affairs to identify sufficient resources from DUL and Pratt to support our students and resolve any potential issue in a timely manner.

For instance, we plan to recruit senior students from the master program at Duke ECE to help our new students when they first arrive at Durham. As such, both the senior and junior students can effectively work together and learn from each other, improving both social and technical skills.

5.5. Student Recruitment

We will market the proposed ECE MEng program, as well as DKU and Duke in general, over multiple communication channels. On-site recruitment events such as summer camps and open houses will be planned. Over these marketing activities, we will particularly emphasize four unique features of our program: (1) offering customized curriculum covering engineering, business and management, (2) obtaining US degree and possibility to work in US, (3) carrying a customized education plan for non-US students to make a smooth transition to US, and (4) providing networking and internship opportunities to acquire industrial experience in China or other neighboring countries.

We propose to recruit students during the 2018/2019 academic year and these students will start their first semester at DKU in Fall 2019. We anticipate hiring our recruitment staff in

Summer 2018, pending approvals by Duke faculty and the Duke and DKU Boards, in order to provide ample time for marketing and recruitment. We expect an initial class size of about 25 students, growing to a steady state of 100 students over 5 years.

We want to start with a small class for a number of reasons. First, we have learned from the experience of other programs at DKU that enrollment numbers are often lower during the first year because it takes time for the community to recognize a new program. Second, a small class during the first year will make program administration more manageable and help to resolve any unanticipated problems. Third, we want to ensure a highly competitive and selective process for both student admission and faculty recruitment, requiring us to grow the program slowly. Fourth, we want to implement and develop other resources (e.g., classrooms, labs, computing infrastructure, etc.) required by our program step by step with careful quality control.

To attract top talent to our proposed program, a dedicated Marketing and Recruiting Manager will be recruited. The manager will closely work with our faculty and staff to advertise and promote the proposed ECE MEng program over the following complementary avenues. The required budget has already been planned in the proposed financial model.

- *Information sessions* will be offered at top Chinese universities to introduce the proposed program, describe the program structure, and explain its competitiveness over other existing master programs in China. In addition to student recruitment, these information sessions help to boost the visibility of the proposed ECE MEng program and DKU in general by broadcasting the information to the faculty, staff and students at other Chinese universities.
- *Summer camps and open houses* will invite prospective students to visit DKU for 2-3 days. These students will be involved in a number of activities to introduce the education environment, extracurricular activities and living condition at DKU. Industrial companies will also be invited to join the summer camp to explain their collaboration with DKU on student recruitment. As a result, students will understand the competitive features and long-term vision of our program. Furthermore, students will be guided to develop their long-term career goal and, most importantly, set up the step-by-step milestones to achieve the goal. At these events, we will explain to the students whether and how the ECE MEng program at DKU can facilitate their career development. Through the interaction with students, we will also evaluate the students based on their creativity, motivation, technical background, communication skills, etc. It facilitates us to identify a set of top students who should be actively recruited for our program during the following academic year.
- *New media*, including WeChat, Weibo, etc., offers effective channels that can broadly advertise the information of our program in China. WeChat has more than 549,000,000 registered users today. Carefully drafted articles will be published over these channels to broadcast and advertise the program information to a broad audience. Based on the statistics data published by the Chinese Ministry of Education (MOE), new media is able to cover more than 6,000,000 students in China today. By taking advantage of such a massive advertisement channel, we hope to deliver the information to every engineering student in China.
- *Research workshops* located at DKU will be jointly organized by Duke and DKU faculty

members. These workshops are expected to bring a large number of faculty members and academic researchers from top Chinese universities so that they are aware of our proposed ECE MEng program and, consequently, will encourage the students in their universities to apply.

The aforementioned channels will be used to boost the reputation of the ECE master programs at both DKU and Duke. After provided with the detailed information of both programs, students can decide the preferred program to apply. It, in turn, would enlarge the application pools for both programs at Duke and DKU. Since 2017, the ECE department at Duke has started to implement a subset of these ideas for student recruitment. A group of ECE faculty members visited several major Chinese cities to host information sessions and a number of WeChat groups were created to advertise the master program for Duke ECE. These activities have helped Duke ECE to attract a large number of high-quality students this year. With the close collaboration between Duke and DKU, we expect to create more efficient and successful recruitment channels in China, thereby helping both Duke and DKU to access high-quality master students.

We will actively encourage female and minority students to apply for our program. During our recruitment events, we will host special sessions for these students. In addition, we will closely work with the faculty members and academic researchers in other universities and encourage their female and minority students to apply. As the undergraduate program at DKU grows, we will further encourage our own undergraduate students to apply to ensure diversity.

6. Student Community

6.1. Graduate Admissions

Admissions to the proposed ECE MEng program will follow a composite of Duke and DKU processes. All applicants must submit their full application packages, including personal statement, reference letters, transcripts, GRE/TOFEL scores, etc., to the online application website at DKU. DKU will be responsible to create and maintain the application web site. The cost of web development has already been budgeted.

A Graduate Admission Committee (GAC) will be formed initially with 5 committee members from both Duke (3 faculty and staff members at Pratt/ECE) and DKU (one DKU faculty and the Marketing and Recruitment Manager). We believe that involving faculty and staff from both Duke and DKU into GAC would take into account the culture and requirements at both campuses. Setting up a “joint” GAC is essential to establish comparable quality across programs at Duke and DKU. As the program grows and more and more applications are received, additional faculty and staff members will be recruited from both Duke and DKU to join GAC in order to handle a large number of applicants.

GAC will first screen all applicants based on test scores and transcripts, using the current Duke ECE requirements to set the minimum threshold. Similar to the master program at Duke ECE, a successful applicant to our proposed ECE MEng program at DKU are expected to hold an undergraduate degree in sciences or engineering. The admission decision will be made based on several factors, including letters of recommendation, undergraduate coursework/preparation, undergraduate GPA, GRE score, etc. The quality of students admitted to the proposed ECE

MEng program, measured by their GPA, GRE scores, etc., should be comparable to that of the existing ECE MS/MEng program at Duke. Table 15 summarizes the average GRE and GPA for admitted MS/MEng students at Duke ECE.

Table 15. Average GRE and GPA for admitted MS/MEng students at Duke ECE

Year	2015	2016	2017
Average GRE	325	324	325
Average GPA	3.7	3.6	3.6

Qualified candidates will then be individually reviewed. Each GAC member is expected to review a dozen applicants and separate them into three categories: (1) definite admits, (2) possible admits, and (3) definite declines. Next, GAC will meet together to determine a tentative list of admitted applicants and the waiting list. Finally, representatives from GAC will interview these candidates by phone to make admission recommendations, pending approval by the Associate Dean for Graduate Programs at DKU, the Associate Dean for Professional Master Programs at Duke Pratt and the Managing Director of Graduate Studies at Duke ECE. If a candidate has already attended our summer camp and interacted with the faculty and staff, the aforementioned phone interview may be waived. During the admission process, GAC will choose a small number of top students and recommend them for scholarship.

The Associate Dean for Graduate Programs at DKU, the Associate Dean for Professional Master Programs at Duke Pratt and the Managing Director of Graduate Studies at Duke ECE must approve these admissions and scholarships, before the offer letters are issued. If Pratt/ECE at Duke cannot hold a large number of incoming MEng students, the Associate Dean for Professional Master Programs at Duke Pratt and the Managing Director of Graduate Studies at Duke ECE will decide the number of students for admission.

6.2. Graduate Studies

Once students enter the proposed ECE MEng program, their study and process will be jointly monitored by the Pratt Office of Master Programs at Duke, the ECE Department at Duke and iAPSE at DKU. A Graduate Study Committee (GSC) will be formed with 5 committee members from both Duke (the Managing Director of Graduate Studies and 2 other faculty and staff members at Pratt/ECE) and DKU (1 DKU faculty and the Program Coordinator) to help students to manage their study plans. GSC is expected to closely interact with both students and other academic units at both DKU and Duke to resolve any issues related to academic matters. In particular, GSC serves the following functions:

- Develop the DKU ECE MEng Bulletin based upon the existing Pratt Professional Masters Bulletin at Duke.
- Review new courses taught at DKU.
- Advise first-year students on course selection and other academic matters.
- Monitor the academic progresses for all students, including courses, summer internship, professional training, etc.

- Review petitions submitted by students for their academic activities including electives, course change, program extension, leave of absence, underloading or overloading, etc.
- Evaluate program by collecting statistical data, student feedback, etc. and preparing annual assessment report.
- Discuss and implement action items to address any outstanding issues and concerns on graduate study.

As the program grows and more and more students are enrolled, additional faculty members will be recruited from both Duke and DKU to join GSC in order to manage a large number of students.

The proposed MEng program will exactly follow the curricular setup of the existing ECE MEng program at Duke Pratt, because the students will receive a Duke degree after graduation. GSC will play an important role to oversee the operation details. Any course taught for the proposed MEng program at DKU must be first approved by the GSC and the Associate Dean for Graduate Programs at DKU, and then by Pratt/ECE by following the same approval process at Duke. All petitions submitted by students for their academic activities including electives, course change, program extension, leave of absence, underloading or overloading, etc. should be approved by the GSC at DKU, the Associate Dean for Graduate Programs at DKU, the Associate Dean for Professional Master Programs at Duke Pratt and the Managing Director of Graduate Studies at Duke ECE. Before the MEng degree is granted to any student, the GSC and the Associate Dean for Graduate Programs at DKU will first check whether the student has fulfilled all the program requirements, and then the Associate Dean for Professional Master Programs at Duke Pratt and the Managing Director of Graduate Studies at Duke ECE must approve it.

6.3. Student Support

DKU currently has a team of 8 staff members to support about 200 students by working on various aspects of student affairs, including housing services, health services, extracurricular activities, counselling and psychological services (CAPS), etc. DKU offers a unique blend of programs and services that strive to meet the needs of students from China, US and other countries. These activities broadly cover sports, fitness and recreation, leadership programs, cultural and recreational excursions, community services, and arts and cultural events. Through a range of integrated support services, academic and personal advising, community outreach programs and co-curricular activities, students are expected to successfully learn the necessary skills and abilities to strengthen and develop their personal and academic lives. Our planned activities help students to quickly become involved citizens who are extensively engaged with DKU and its surrounding local communities. Our master students are expected to live in off-campus apartments. Instead of asking each student to find his/her own apartment, DKU will rent a few apartment buildings so that all students could live together. DKU has already been exploring several possible candidates such as Fortune Plaza that is about 1.5 miles away from campus. We will actively work with the Associate Dean for Student Life at DKU to secure the required resources (e.g., additional staff members) and ensure that all students of the proposed

ECE MEng program receive strong supports while studying and living at DKU.

We will coordinate with the VP of Student Affairs at Duke to offer strong supports to our students, including housing services, health services, counselling and psychological services (CAPS), etc. International House (I-House) at Duke offers a large number of programs to help new international students to adjust their new life at Duke when they first arrive at Durham. Graduate students at Duke currently rent off-campus apartments. We will work with Student Affairs to organize orientations to help students to secure housing, health insurance, etc.

As the student number grows from 25 to 100 over 5 years, we anticipate that the required resources may substantially vary over time. Hence, it is important for us to dynamically adjust our support in order to meet the time-varying demands. For instance, we plan to recruit senior students from the master program at Duke ECE to help our new students when they first arrive at Durham. As such, both the senior and junior students can effectively work together and learn from each other, improving both social and technical skills.

We recognize that the proposed ECE MEng program, along with other masters programs at Duke that are growing their enrollments, can require additional resources such as library support personnel. This growth in required library resources is clearly a demand on the university that is beyond our own particular program, but is one in which our program can help to share allocated costs to meet this growing need. With the increase in the number enrolled students comes an increase in the allocated costs to help defray such demand, and we would gladly share in a fractional contribution to the increased support required based on our own program's demonstrated demand.

6.4. Career Services

All students in the proposed ECE MEng program are expected to complete their summer internship at the end of the first year. The GSC, the Office of Industrial Engagement at iAPSE and the Career Center at DKU will work together to help students on social networking, internship placement, professional training, etc. A new Director has recently been recruited for the Career Center at DKU to oversee and accommodate the needs of career development of our students. To closely connect our students to the local industry in China, we plan to hold an annual career fair at DKU in spring. By taking advantage of the broad network of industrial member companies of iAPSE, students are expected to find the appropriate industrial positions that match their technical background for summer internship.

Most students in our program will look for a job in the US after graduation. We will have a dedicated staff member from the Pratt Office of Master Programs to offer career services at Duke. The Pratt Office of Master Programs has been offering weekly events (e.g., seminar series, career counseling, industrial networking, resume preparing, etc.) to help students to quickly adjust to the US job market. We anticipate that the majority of our students will find technical jobs in leading US companies and will grow to technical leaders in few years.

To seamlessly integrate the first-year summer internship with the second-year job search, the Office of Industrial Engagement at iAPSE and the Career Center at DKU will collaborate with

the Pratt Office of Master Programs to establish an Early Recruitment Program (ERP) with its member companies that operate R&D offices in both China and US. The idea is for companies to closely work with our students during the summer internship. Immediately after the internship is done and the student arrives in the US, the host company can interview the student at its US site and provide an early offer for a full-time job as soon as possible. iAPSE will play an important role to initiate and promote the aforementioned ERP for the proposed ECE MEng program, as well as other future programs affiliated with iAPSE.

7. Program Management and Evaluation

7.1. Program Management

To ensure that the proposed ECE MEng program meets the needs of faculty, staff and students at both Duke and DKU, the Office of DKU Programs at Duke, the Pratt Office of Master Programs at Duke, the ECE Department at Duke and iAPSE at DKU will jointly manage the program. We will establish a Program Management Committee (PMC) with 6 committee members from both Duke (3 faculty and staff members at Pratt/ECE) and DKU (the Program Director and two other faculty or staff members at iAPSE). A joint PMC with committee members from both Duke and DKU demonstrates the collaborative spirit of our program design.

The PMC will convene on a biweekly basis, as needed, and should agree on all major program decisions, as well as being available for consultations on other minor issues. The PMC will appoint the committee members for the Graduate Admission Committee (GAC) and Graduate Study Committee (GSC). It may form additional committees for faculty recruitment, course approval, etc. The PMC will also make decisions about hiring adjuncts at DKU and the Vice Chancellor for Academic Affairs at DKU makes decisions about conferring visiting position titles.

We anticipate that the PMC will play a central role in dealing with program decisions. The PMC will meet with the Associate Vice Provost for DKU Programs, the Dean and Associate Dean of Pratt and the Chair of ECE to ensure that they are involved in logistical details and the first-stage probationary review of the proposed ECE MEng program. All of them have endorsed the program and its governance structure, as shown by the support letters. The PMC will ensure open lines of communication between different parties (e.g., DKU, Duke, Pratt, ECE, etc.) and to ensure parity in quality across all the programs. Since it is a new program, the PMC is expected to consult with the Duke leadership about policies and guidelines on a regular basis.

In general, new developments or changes for the proposed MEng program should be approved by both Duke and DKU. The Program Management Committee (PMC), composed of members from the Office of DKU Programs at Duke, the Pratt Office of Master Programs at Duke, the ECE Department at Duke and iAPSE at DKU, will communicate with the relevant committees at Duke and DKU to finish the approval process. Note that the aforementioned guidelines are not applicable to the regular MS/MEng programs at Duke. Duke is fully responsible for these regular programs and DKU should not be involved with them.

7.2. Faculty Appointment, Promotion and Tenure

Procedures about faculty appointment, promotion and tenure at DKU are outlined in the policy of "Academic Tenure and Faculty Appointment, Promotion and Tenure" approved by the DKU faculty and board. Details specific to our program include a search committee composed of two Duke ECE faculty members and the Program Director, who will review all application materials. Selected faculty candidates will be interviewed at the ECE department at Duke. After the interview, the search committee will collect feedback and then nominate successful candidates to the DKU Faculty Appointment Committee, which includes 9 faculty members in total (5 from Duke, 2 from DKU and 2 from Wuhan University). This committee then makes recommendation to the Executive Vice Chancellor for appointment. Faculty members might be recruited for tenure-track or non-tenure-track positions. Duke will be fully responsible for faculty requirement at Duke. DKU will not be involved in faculty recruitment at Duke.

Each faculty member will be reviewed annually at DKU. The pre-tenure period is seven years of full-time service. The initial appointment is for a term of four years. Renewal of the initial appointment for a second four-year term will be made on the basis of careful review by a dedicated review committee composed of ECE faculty from both Duke and DKU, favorable recommendation by the DKU Faculty Appointment Committee, and favorable recommendation by the DKU Vice Chancellor for Academic Affairs. All promotions to associate professor with tenure or full professor with tenure shall be considered by a dedicated review committee with ECE faculty from both Duke and DKU, the APT committee composed of 9 faculty members in total (5 from Duke, 2 from DKU and 2 from Wuhan University), and the DKU Vice Chancellor for Academic Affairs. The three primary criteria for tenure evaluation are quality of (1) teaching, (2) research and/or other scholarly activities and (3) service to the university. Tenure appointments will be granted at DKU (not at Duke).

7.3. Learning Objectives and Outcomes

The proposed ECE MEng Program is a technical degree program for the technical field of electrical and computer engineering. One of the emerging themes in the education of practicing engineers in the 21st century is the desire to prepare graduates for the global economy both through deeper technical understanding and broader knowledge in the fundamentals of engineering design, innovation, business, and leadership. The proposed MEng program combines graduate-level technical knowledge in ECE, core business fundamentals and extensive international experience to offer an applied non-thesis degree. It train students with the skills to effectively contribute to the technical needs of the 21st century global organization, thus better preparing students to work in industry and eventually become future global industrial leaders.

In particular, our program is composed of a core curriculum consisting of industry preparation courses with business fundamentals, departmental courses designed for the ECE area, technical electives that are customized by the students in their area of interest, and a summer internship designed to further enhance the knowledge and skills for our students to work in a global environment. This broad curriculum develops engineering professionals ready to address

today's complex technical problems with innovative solutions.

To maximize education outcome, we will clearly define learning objectives for students to gain the appropriate knowledge and necessary skills. Students who fail to maintain a B average on their coursework will be placed on academic probation for a semester. Learning objectives will be available in written form and consistent with outcomes and assignments. Each semester, course syllabuses will be collected and available for review. Faculty will be encouraged to develop homework assignments and course projects and exams geared toward applying the skills learned in the classroom.

The Graduate Study Committee (GSC) will meet with each student to discuss study plan, learning objectives, career goals, and most importantly, the timelines for all important milestones. For instance, immediately after students start their first year at DKU, GSC should review and approve the course plan for each student.

We will use a set of assessment tools, including course evaluations, graduate exit surveys, GSC assessment report, town hall meetings, workshop surveys, employer surveys, etc., to ensure parity in expected learning outcomes. The timelines and formats of these tools are similar to what are currently used by the ECE MEng program at Duke. For example, course evaluations will be conducted at the end of each semester and internship evaluations will be performed at the end of each summer. Summaries of these evaluations will be shared with students, faculty and administrators both at DKU and Duke to identify valuable findings that influence the actions to further improve the program. Section 9.4 lists specific student learning outcomes and assessment tools for the proposed ECE MEng program.

7.4. Accreditation and Assessment

Because this is a new MEng program, we will work with the Office of the Vice Provost for Academic Affairs and the Office of DKU Programs to obtain SACS approval and accreditation prior to the commencement of the program. Assessment of all aspects of DKU programs is an important factor for the ongoing refinement and evolution of DKU as an institution. We are expected to establish a variety of assessment methodologies for course content, pedagogical effectiveness, faculty experience, and student outcomes. Considerable data are being collected with the idea of making assessment not only of benefit for accreditation purposes but more broadly as a means to improve and refine the educational experience at DKU. We can envision that the ECE MEng program at DKU will be refined over time to take into account the lessons learned from these assessments, while remaining within the general scope of practice of this proposal. In that sense, the ECE MEng program will be innovative and involve exploration of new pedagogical methods. However, we do feel that its overall objectives that drive our vision for global and interdisciplinary engineering education and research should remain. Innovations in educational experience borne out at DKU that are translatable to Duke will be communicated back through regular discussions between program directors at Duke and DKU.

We will review the program every year in accordance with SACS accreditation. At the end of each year, the Program Director will submit an annual report to the Vice Provost for

Academic Affairs and the Associate Vice Provost for DKU Programs, taking into account admissions, aggregate course evaluations, exit/satisfaction survey, and job placement experience (all of which will be tracked on a yearly basis). After an initial three-year period, we will carry out a more extensive review process. We draw upon current assessment procedures at Duke for evaluating courses and teaching so as to ensure that the program is meeting the objectives laid out in our program plan. In particular, we will ensure that our assessment procedures follow the existing assessment procedures that are used for SACS at Pratt, including standardized evaluation data on courses, internship and student exit survey data.

Beyond the standard evaluation metrics, we have identified other criteria that would allow us to measure the success of our proposed ECE MEng program. Although the program will gradually grow to its steady state over 5 years, we want to define several critical performance indicators for the first three years in order to quantitatively assess the program at an early stage.

- *Faculty recruitment*: We are committed to successfully recruit 3 new faculty members at DKU and 3 new faculty members at Duke by Summer 2022. Along with Prof. Xin Li, the Director of iAPSE, with 50% appointment at DKU and 50% appointment at Duke, there will be 3.5 full-time faculty members affiliated with our proposed ECE MEng program at both DKU and Duke by Summer 2022.
- *Student enrollment*: We should successfully achieve our enrollment target listed in Table 6 on Page on Page 17. Namely, 65 students or more should be recruited for 2021/2022. The quality of these students, measured by their GPA, GRE scores, etc., should be comparable to that of the existing ECE MS/MEng program at Duke.
- *Student education*: For the students enrolled in the proposed ECE MEng program, their GPA will be continuously monitored and assessed at DKU and Duke. The GPA of these students should be comparable to that of the regular ECE MS/MEng students at Duke.
- *Summer internship*: Being part of iAPSE at DKU, students in our proposed ECE MEng program are expected to join a number of leading-edge industrial member companies in China or other neighboring countries for summer internship. By Summer 2022, we anticipate that our proposed program will be connected to more than 10 industrial companies that recruit summer interns from our proposed ECE MEng program.
- *Job placement*: We anticipate that a large portion of students graduated from the proposed program will find jobs in their technical areas in the US. These students are expected to expand their working experience in US companies and may consider moving to other countries (e.g., returning to China) after 3-5 years. The other students are expected to find jobs in other countries (e.g., Europe, Asia, etc.), immediately after their graduation. The start-up salary of these students should be comparable to that of the regular ECE MS/MEng students at Duke. By Summer 2022, we will already graduate 65 students and will have sufficient data to demonstrate these goals on job placement.

8. Risk Assessment

8.1. Challenges and Mitigations

Student Recruitment

Similar to any other new program, we expect enrollment to be smaller in the first few years. Because the proposed ECE MEng program does not have any historical data on job placement and career development, it may take few years to quantitatively prove the success of our program and, consequently, attract a large batch of high-quality students. To mitigate this challenge, we will quickly establish and grow our industrial connection through iAPSE to secure highly competitive job opportunities offered by a number of leading-edge companies. Such a strategy of seeking industrial partnership is feasible because a large number of industrial companies in China are now looking for university collaborations for talent recruitment. These job opportunities, along with our carefully-designed education plans, will be broadly advertised and promoted for prospective students over the marketing channels discussed in Section 5.5.

The other challenge on student recruitment stems from the fact that the MEng program offered by conventional Chinese universities has a completely different setup. The conventional MEng program in China requires students to spend less time and take fewer courses than the MS program. Hence, the MEng students trained by conventional Chinese universities are less competitive than their MS students, and most Chinese students prefer to pursue an MS degree, instead of an MEng degree in China. To address this issue, we will clearly explain the curriculum setup of our proposed MEng program, emphasize its difference against the conventional MEng program in China, and highlight its competitive features over the MS program. The aforementioned information will be distributed over our marketing and advertisement channels.

Faculty Recruitment

Recruiting high-quality faculty at DKU is another critical challenge, because DKU is a relatively new university. We will explain to the faculty candidates about several competitive aspects of working at DKU. First, the strong industrial connection that iAPSE aims to establish will create an innovative environment for engineering education. Second, the connection with Duke allows DKU faculty to access many US resources (e.g., mentored by a senior faculty at Duke) while working in China. Third, the compensation package offered by DKU, including salary, health insurance and education allowance, is highly competitive over other universities in China.

Service Time

To build a new program involving both Duke and DKU, a large amount of service time is needed from both faculty and staff. Workload should be carefully balanced among all faculty and staff members, without overloading a specific person. In addition, for a faculty or staff member who extensively contributes to the proposed program, he/she should be recognized and compensated for the work that is beyond the normal job responsibility.

Other Risks

If the proposed MEng program is successfully executed, it will advertise the ECE master

programs for both DKU and Duke and showcase successful stories for our master students. It, in turn, will boost the reputation for the master programs at both DKU and Duke and attract a large number of high-quality students to our application pools and, eventually, to our programs.

In the worst case, if the proposed MEng program fails due to unexpected reasons, it may affect the reputation of Duke/Pratt/ECE in China. Three action items should be pursued to mitigate this risk. First, we should carefully design the execution plan and closely coordinate all parties to minimize the risk of failure. Second, we should clearly distinguish the regular Duke ECE program and the proposed DKU ECE program. As such, students understand that they are two different programs with different management structures and financial models, even though both programs offer the same Duke degree. Third, in case the proposed MEng program fails, we should fully understand the failure reason and quickly come up with a "rescue plan" to minimize the damage to our students.

Finally, it is worth mentioning that if we do not build the proposed MEng program now, we will face the risk of losing our opportunity to grow the global presence and leadership in China. A large number of top US engineering schools (e.g., Berkeley, UMich, UIUC, etc.) are exploring the Chinese opportunity and developing a variety of education programs there. Without establishing our own footprint in China, we may quickly become less competitive than our competitors. Based on the recent admission data for our regular ECE master program at Duke, we already observe an increasingly high competition from other top US schools.

8.2. Future Growth

Once the proposed ECE MEng program is established, we will begin to explore new opportunities for future growth:

- *Exchange program*: In addition to the proposed degree program that is highly customized for students in China and its neighboring countries, we plan to set up exchange program for US/European students to visit DKU for one semester. The exchange program would expose these students to the Chinese language, culture and society, thereby bring them global knowledge and experience that cannot be acquired by the conventional classroom education in the US/Europe.
- *Industrial training*: Educating industrial engineers and renovating their technical knowledge has an extremely high demand in China, because most Chinese companies want to upgrade their labor-intensive production to high-tech business. To explore this education opportunity, we plan to organize intensive training courses during the summer. These courses should be particularly designed to meet the industrial needs. Each course will offer lectures and labs on a focused topic (e.g., software engineering) over 2-3 days.
- *Other disciplines*: One important mission of iAPSE is to establish and grow education and research in the area of applied science and engineering at DKU. As mentioned at the beginning of this proposal, creating the proposed ECE MEng program is only a very first step to implement our long-term, strategic vision for iAPSE. For this reason, we will develop education programs in other applied science and engineering fields such as interdisciplinary data analytics. In the long term, iAPSE, collaborating with other programs at Duke and DKU, is expected to initiate,

drive and lead the “Eastern Silicon Valley” with high-tech industry in Asia.

While the implementation details of the aforementioned activities require further discussions involving multiple parties at both Duke and DKU, we anticipate that all of them would contribute to a positive financial margin that would further strengthen all initiatives by iAPSE at DKU.

9. Appendices

9.1. Courses Descriptions and Learning Opportunities

Technical Courses at DKU

- *Fundamentals of Computer Systems and Engineering* (ECE 550, 3 credits, CE): This course is designed for master students whose undergraduate background did not cover computer systems. Topics covered include digital logic, assembly programming, computer architecture, memory hierarchies and technologies, I/O, hardware implementation in VHDL, operating systems, and networking.
- *Programming, Data Structures, and Algorithms in C++* (ECE 551, 3 credits, CE): Students learn to program in C and C++ with coverage of data structures (linked lists, binary trees, hash tables, graphs), Abstract Data Types (Stacks, Queues, Maps, Sets), and algorithms (sorting, graph search, minimal spanning tree). Efficiency of these structures and algorithms is compared via Big-O analysis. Concurrent (multi-threaded) programming is briefly discussed. Emphasis is placed on defensive coding, and use of standard UNIX development tools in preparation for students' entry into real-world software development jobs.
- *Random Signals and Noise* (ECE 581, 3 credits, SP): This course introduces mathematical methods of describing and analyzing random signals and noise. It reviews basic probability theory, joint, conditional, and marginal distributions, and random processes. The course also covers time and ensemble averages, correlation, power spectra, optimum linear smoothing and predicting filters, optimum signal detection, parameter estimation, and statistical signal processing.
- *Vector Space Methods with Applications* (ECE 590, 3 credits, SP): This course covers fundamental concepts of logic including sets, axioms, quantifiers, implications, necessary and sufficient conditions. It studies formal definitions for open sets, closed sets, convergence, limit points, completeness and continuous functions. It introduces the projection and optimization theorems and illustrates their applications. It also discusses the notions of linear operators, fundamental subspaces, matrix representations, inverses and pseudoinverses, eigenvalues and eigenvectors, and singular value decomposition.
- *Physical Imaging* (New course, 3 credits, SW): This course teaches multidimensional field models and propagation, detection and analysis of physical data. Students will develop ability for comparative system analysis and design and ability for mathematical modeling of physical systems. Students will understand fundamental limitations in the capacity to detect and observe physical systems. Students will specifically learn the physical nature of electromagnetic signals and images and how this physical data is transformed and communicated in digital systems.
- *Numerical Methods for Scientific Computing and Machine Learning* (New course, 3 credits, CE): This course teaches a number of commonly-used algorithms, including linear solver, regression, classification, nonlinear optimization, etc., and, most importantly, how they can be used to solve practical engineering problems. Students are expected to develop the mathematical skills to build customized algorithms, as well as the background required to use commercial tools.
- *Systems Programming and Engineering* (ECE 650, 3 credits, CE): This course focuses on a

range of topics that are central to both the design of operating systems and the programming system-level software. Students will apply knowledge of basic concepts in operating systems, networking, and programming towards these two areas. Topics covered will include concurrency, process management, hypervisors, networking, security, databases, and file systems. Students will be expected to demonstrate their understanding in these areas through a series of programming assignments covering these topics.

- *Software Engineering* (ECE 651, 3 credits, CE): This course teaches students about all steps of the software development lifecycle: requirements definition, design, development, testing, and maintenance. The course assumes that students are skilled object-oriented programmers from prior courses, but will include a rapid introduction to Java. Students complete team-based semester-long software project which will progress through all phases of the software lifecycle.
- *Pattern Classification and Recognition Technology* (ECE 681, 3 credits, SP): This course covers theory and practice of recognition technology, including pattern classification, pattern recognition, and automatic computer decision-making algorithms. Applications covered include medical diseases, severe weather, industrial parts, biometrics, bioinformatics, animal behavior patterns, image processing, and human visual systems. This course prepares students for advanced study of data fusion, data mining, knowledge base construction, problem-solving methodologies of "intelligent agents" and the design of intelligent control systems.
- *Probabilistic Machine Learning* (New course, 3 credits, SP): This course introduces machine learning techniques, including graphical models, latent variable models, dimensionality reduction techniques, statistical learning, regression, kernel methods, state space models, HMMs, MCMC, etc.
- *Computational Photography* (New course, 3 credits, PH): This course teaches the mathematical nature of images and the computational transformation from analog sensor data to digital representations. Students will learn how to manipulate image data using modern digital hardware and software, and understand modern operating systems and software libraries in the context of digital cameras and mobile devices. Students will also be exposed to the system development process and legal and technical issues associated with data security, cloud services and digital representation of the physical world.

Industrial Preparation Courses at Duke

- *Management of High Tech Industries* (MENG 540, 3 credits): This course addresses critical qualities of leadership, management skills, and decision making in complex environments. Essential topics include leadership and communication principles, strategic decision making where outcomes depend on high technology, management of project-based and team-based organizational structures, and the role of the manager in expertise driven organizations.
- *Business Fundamentals for Engineers* (MENG 570, 3 credits): This course provides an overview of the essentials of intellectual property, marketing, accounting and finance, and business strategies for technology companies. Principles covered include marketing, methods of distributing products, analysis of marketing situations, and connections between marketing and

other functions of the business; accounting and finance, including time value of money, financial statements, balance sheets, cash flow and risk, receivables, inventories, assets and liabilities, investments, and shareholders' equity; intellectual property, including patenting process, drafting claims, legal recourses for patent infringement, patent appeal process, patents strategies, the Patent Cooperation Treaty and the European Union Patenting System. Copyright, trademarks and trade secrets; and technology based business strategy topics such as Forces of Strategic Space, Blue Ocean Strategy, and Disruptive Technologies.

Technical Courses at Duke

- *Foundations of Nanoscale Science and Technology* (ECE 511, 3 credits, NS): This course is designed to introduce students to the interdisciplinary aspects of nanoscience by integrating important components of the broad research field together. This integrated approach will cross the traditional disciplines of biology, chemistry, electrical and computer engineering, computer science, and physics. It covers fundamental properties of materials at the nanoscale, synthesis of nanoparticles, characterization tools, and self-assembly.
- *Quantum Mechanics* (ECE 521, 3 credits, NS): This course discusses wave mechanics including elementary applications, free particle dynamics, Schrödinger equation including treatment of systems with exact solutions, and approximate methods for time-dependent quantum mechanical systems with emphasis on quantum phenomena underlying solid-state electronics and physics.
- *Nanophotonics* (ECE 545, 3 credits, PH): This course covers theory and applications of nanophotonics and sub-wavelength optics. Topics of interest include photonic crystals, near-field optics, surface-plasmon optics, microcavities, and nanoscale light emitters.
- *Optoelectronic Devices* (ECE 546, 3 credits, PH): This course covers devices for conversion of electrons to photons and photons to electrons. It also covers optical processes in semiconductors, including absorption, spontaneous emission and stimulated emission. Several important optoelectronic devices will be discussed: light-emitting diodes, semiconductor lasers, quantum-well emitters, photodetectors, modulators and optical fiber networks.
- *Compiler Construction* (ECE 553, 3 credits, CE): It covers the fundamentals of compiler design. Students will develop a working compiler, writing all stages required to take source code as input and produce working assembly as output: lexical analysis, parsing, type checking, translation to intermediate representation, instruction selection, liveness analysis, and register allocation.
- *Probability for Electrical and Computer Engineers* (ECE 555, 3 credits, CE): This course teaches basic concepts and techniques of stochastic modeling of systems with applications to performance and reliability of computer and communications system. It covers elements of probability, random variables, expectation, conditional distributions, stochastic processes, discrete- and continuous-time Markov chains, and introduction to queuing systems and networks.
- *Electromagnetic Theory* (ECE 571, 3 credits, SW): This course covers the classical theory of Maxwell's equations, electrostatics, magnetostatics, boundary value problems including

numerical solutions, currents and their interactions, and force and energy relations.

- *Waves in Matter* (ECE 574, 3 credits, SW): This course teaches wave phenomena that occur in materials based on fundamental formulations for electromagnetic and elastic waves. Examples from these and other classes of waves are used to demonstrate general wave phenomena such as dispersion, anisotropy, and causality; phase, group, and energy propagation velocities and directions; propagation and excitation of surface waves; propagation in inhomogeneous media; and nonlinearity and instability. Applications that exploit these wave phenomena in general sensing applications are explored.
- *Digital Signal Processing* (ECE 582, 3 credits, SP): This course introduces fundamental algorithms used to process digital signals, including basic discrete time system theory, discrete Fourier transform, FFT, linear filtering, linear production and Wierner filter, adaptive filters and applications, the LMS algorithm and its convergence, recursive least-squares filters, nonparametric and parametric power spectrum estimation, minimum variance and eigenanalysis algorithms for spectrum estimation.
- *Adaptive Filters* (ECE 686, 3 credits, SP): This course covers adaptive digital signal processing with emphasis on the theory and design of finite-impulse response adaptive filters. Topics of interest include stationary discrete-time stochastic processes, Wiener filter theory, the method of steepest descent, adaptive transverse filters using gradient-vector estimation, analysis of the LMS algorithm, least-squares methods, recursive least squares and least squares lattic adaptive filters. Application examples include noise canceling, channel equalization, and array processing.

9.2. Faculty Bio

The bios are included for the following faculty members. Other faculty members will be recruited once the program is approved.

- Xin Li (50% appointment at Duke and 50% appointment at DKU)
- Ming Li (100% appointment at DKU and will join DKU in March 2018)

Xin Li

Department of Electrical & Computer Engineering, Duke University, Durham, NC 27708
Institute of Applied Physical Sciences and Engineering, Duke Kunshan University, Kunshan, Jiangsu, P. R. China, 215316
Email: xinli.ece@duke.edu

EDUCATION

- PhD in Electrical & Computer Engineering, Carnegie Mellon University, PA, USA, May. 2005
  Dissertation: Statistical Modeling, Analysis and Optimization for Analog and RF ICs
  Advisor: Lawrence Pileggi
- MS in Electronics Engineering, Fudan University, Shanghai, China, Jun. 2001
  Thesis: Wavelet and Its Application to Integrated Circuit Analysis
  Advisor: Xieting Ling
- BS in Electronics Engineering, Fudan University, Shanghai, China, Jun. 1998
  Thesis: Fetal E.C.G. Detection Based on Blind Signal Separation
  Advisor: Xieting Ling

RESEARCH INTERESTS

- **Data analytics for advanced manufacturing**: Develop hardware systems and statistical algorithms to sense and process complex, heterogeneous manufacturing data to address process complexity, process variability and capacity constraint.
- **Data learning for connected autonomous vehicle**: Build low-cost, reliable and secure system implementation, including both hardware and software, for safe and comfortable driving.
- **Medical and health informatics**: Create data-driven solutions for emerging and interdisciplinary problems in order to improve health service quality and reduce healthcare cost.
- **Data-driven business intelligence**: Invent new engineering techniques and tools to sense raw data and then transfer them into meaningful and useful information for business analysis such as behavior modeling and decision making.

WORKING EXPERIENCE

- 07/2017 – Present: Director
  Data Science Research Center, Duke Kunshan University
  Kunshan, Jiangsu, P. R. China
- 07/2017 – Present: Director
  Institute of Applied Physical Sciences and Engineering, Duke Kunshan University
  Kunshan, Jiangsu, P. R. China
- 01/2017 – Present: Professor
  Institute of Applied Physical Sciences and Engineering, Duke Kunshan University
  Kunshan, Jiangsu, P. R. China
- 01/2017 – Present: Professor
  Department of Electrical & Computer Engineering, Duke University
  Durham, NC, USA
- 07/2013 – 12/2016: Associate Professor
  Department of Electrical & Computer Engineering, Carnegie Mellon University
  Pittsburgh, PA, USA
- 03/2014 – 01/2015: Assistant Director

Center for Silicon System Implementation, Carnegie Mellon University
Pittsburgh, PA, USA

- 07/2010 – 06/2013: Assistant Professor
  Department of Electrical & Computer Engineering, Carnegie Mellon University
  Pittsburgh, PA, USA
- 11/2009 – 10/2012: Assistant Director
  FCRP Center for Circuit and System Solutions, Carnegie Mellon University
  Pittsburgh, PA, USA
- 07/2007 – 06/2010: Assistant Research Professor
  Department of Electrical & Computer Engineering, Carnegie Mellon University
  Pittsburgh, PA, USA
- 06/2005 – 06/2007: Post-doctoral Fellow
  Department of Electrical & Computer Engineering, Carnegie Mellon University
  Pittsburgh, PA, USA
- 02/2007 – 04/2007: Engineering Manager
  Extreme DA Inc.
  Pittsburgh, PA, USA
- 06/2005 – 01/2007: Chief Technical Officer
  Xigmix Inc.
  Pittsburgh, PA, USA
- 04/2004 – 04/2004: Technical Staff (Internship)
  Extreme DA Inc.
  Palo Alto, CA, USA

HONORS & AWARDS

International Awards

- Fellow, Institute of Electrical and Electronics Engineers, 2017
- Best Paper Nomination, Design Automation Conference, 2016
- IEEE Donald O. Pederson Best Paper Award, 2016
- Best Paper Nomination, Design Automation Conference, 2015
- Best Paper Award, International Symposium on Integrated Circuits, 2014
- Best Paper Nomination, International Conference on Computer-Aided Design, 2014
- Best Paper Nomination, Design Automation Conference, 2014
- IEEE Donald O. Pederson Best Paper Award, 2013
- NSF CAREER Award, 2012
- IEEE/ACM William J. McCalla ICCAD Best Paper Award, 2011
- Best Paper Award, Design Automation Conference, 2010
- Senior Member, Institute of Electrical and Electronics Engineers, 2010
- Winner of Data Analysis Competition, International Conference on Biomagnetism, 2010
- Best Paper Nomination, Design Automation Conference, 2006
- IEEE/ACM William J. McCalla ICCAD Best Paper Award, 2004

National Awards, P. R. China

- Shanghai One-thousand Talents, 2016

STUDENT AWARDS

- Shupeng Sun, A. G. Milnes Award, ECE Department at Carnegie Mellon University, 2016
- Shupeng Sun, Best Student Paper Nomination, Custom Integrated Circuits Conference, 2015
- Shupeng Sun, Second Place, ACM Student Research Competition Grand Finals, 2015
- Shupeng Sun, Gold Medal, ACM Student Research Competition at ICCAD, 2014
- Shupeng Sun, Best Poster Award, DAC PhD Forum, 2014
- Wangyang Zhang, ACM SIGDA Outstanding PhD Dissertation Award, 2014
- Wangyang Zhang, A. G. Milnes Award, ECE Department at Carnegie Mellon University, 2013

TEACHING EXPERIENCE

Duke Kunshan University, Kunshan, Jiangsu, P. R. China

- 2017 Fall: CS282K: Numerical Methods for Scientific Computing and Machine Learning (Course: ???, Instructor: ???)

Carnegie Mellon University, Pittsburgh, PA, USA

- 2016 Fall: 18-660: Numerical Methods for Engineering Design and Optimization (Course: 4.6/5.0, Instructor: 4.7/5.0)
- 2016 Spring: 18-202: Mathematical Foundations of Electrical Engineering (Course: 3.9/5.0, Instructor: 4.1/5.0)
- 2015 Fall: 18-660: Numerical Methods for Engineering Design and Optimization (Course: 4.5/5.0, Instructor: 4.6/5.0)
- 2015 Spring: 18-202: Mathematical Foundations of Electrical Engineering (Course: 4.1/5.0, Instructor: 4.4/5.0)
- 2014 Fall: 18-660: Numerical Methods for Engineering Design and Optimization (Course: 4.5/5.0, Instructor: 4.5/5.0)
- 2014 Spring: 18-202: Mathematical Foundations of Electrical Engineering (Course: 4.6/5.0, Instructor: 4.7/5.0)
- 2013 Fall: 18-660: Numerical Methods for Engineering Design and Optimization (Course: 4.6/5.0, Instructor: 4.5/5.0)
- 2013 Spring: 18-202: Mathematical Foundations of Electrical Engineering (Course: 4.3/5.0, Instructor: 4.3/5.0)
- 2012 Fall: 18-660: Numerical Methods for Engineering Design and Optimization (Course: 4.6/5.0, Instructor: 4.6/5.0)
- 2012 Spring: 18-202: Mathematical Foundations of Electrical Engineering (Course: 4.2/5.0, Instructor: 4.0/5.0)
- 2011 Fall: 18-660: Numerical Methods for Engineering Design and Optimization (Course: 4.5/5.0, Instructor: 4.6/5.0)
- 2011 Spring: 18-202: Mathematical Foundations of Electrical Engineering (Course: 4.2/5.0, Instructor: 4.5/5.0)
- 2010 Fall: 18-660: Numerical Methods for Engineering Design and Optimization (Course: 4.5/5.0, Instructor: 4.5/5.0)
- 2009 Fall: 18-660: Numerical Methods for Engineering Design and Optimization (Course: 4.0/5.0, Instructor: 4.3/5.0)
- 2009 Spring: 18-762: Circuit Simulation: Theory and Practice (Course: 4.8/5.0, Instructor: 4.8/5.0)
- 2008 Fall: 18-623: Analog Integrated Circuit Design (Course: 4.6/5.0, Instructor: 4.6/5.0)
- 2008 Spring: 18-869A: Statistical IC Design (Course: 4.7/5.0, Instructor: 4.9/5.0)
- 2005 Fall: 18-623: Analog Integrated Circuit Design (Course: 4.7/5.0, Instructor: 4.6/5.0)

RESEARCH FUNDING

Principal Investigator, Duke University, Durham, NC, USA

- **Xin Li** (Duke), "Big data analytics for advanced manufacturing," *Foxconn Technology Group*, USD $93,984, 07/2017–06/2018 (Gift Funding).
- **Xin Li** (Duke), "Efficient statistical validation and probabilistic design," *Cadence Design Systems Inc.*, USD $65,000, 01/2017–12/2017 (Gift Funding).
- **Xin Li** (Duke), "SHF: Small: Re-thinking polynomial programming: efficient design and optimization of resilient analog/RF integrated systems by convexification," *National Science Foundation*, USD $350,000, 07/2016–06/2019.

Principal Investigator, Duke Kunshan University, Kunshan, Jiangsu, P. R. China

- **Xin Li** (DKU), "Learning-based optimization for physical layer implementation of 5G wireless communication," *Huawei*

Technologies Corporation, RMB ¥600,000, 09/2017–08/2018.

Principal Investigator, Carnegie Mellon University, Pittsburgh, PA, USA

- **Xin Li** (CMU), "Big data analytics for advanced manufacturing," *Foxconn Technology Group*, USD $102,512, 07/2016–06/2017 (Gift Funding).
- **Xin Li** (CMU), "Wafer-level defect pattern detection", *Intel Corporation*, USD $40,000, 07/2016–12/2016.
- **Xin Li** (CMU), "Novel design and evaluation of AI components in connected autonomous vehicles," *Toyota InfoTechnology Center*, USD $60,000, 01/2016–06/2016 (Gift Funding).
- **Xin Li** (CMU) and Aswin Sankaranarayanan (CMU), "Low-cost energy-efficient hierarchical compressive sensing for image restoration, synthesis and classification," *Intel Corporation*, USD $310,260, 09/2014–08/2017.
- **Xin Li** (CMU) and Ming Li (SYSU), "Algorithm and hardware co-design for ultra-low-power data processing of electrocardiogram biometrics," *CMU-SYSU Collaborative Innovation Research Center*, USD $114,651, 01/2014–12/2014.
- **Xin Li** (CMU), "SHF: Small: Bayesian model fusion: a statistical framework for efficient pre-silicon validation and post-silicon tuning of complex analog and mixed-signal circuits," *National Science Foundation*, USD $360,839, 07/2013–06/2016.
- **Xin Li** (CMU), "Bayesian framework for electrical validation," *Intel Corporation*, USD $70,000, 01/2013–12/2014 (Gift Funding).
- **Xin Li** (CMU), "CAREER: Maximum-information memory system: theory, implementation and application," *National Science Foundation*, USD $400,000, 01/2012–12/2016.
- **Xin Li** (CMU), "Statistical methods for nanoscale variability modeling and characterization," *FCRP Center for Circuit and System Solutions*, USD $245,000, 11/2010–12/2012.
- **Xin Li** (CMU), "Self-healing memory systems for maximum-information data storage," *FCRP Center for Circuit and System Solutions*, USD $115,000, 11/2010–10/2011.
- **Xin Li** (CMU), "SHF: Small: Collaborative Research: Fast sign-off of nanoscale memory: from predictive device modeling to statistical circuit synthesis," *National Science Foundation*, USD $240,874, 08/2010–07/2013 (Collaborative Project with Yu Cao at ASU).
- **Xin Li** (CMU), "Efficient sensitivity analysis and worst-case prediction for IC power grid," *Mentor Graphics Inc.*, USD $50,000, 01/2010–12/2010 (Gift Funding).
- **Xin Li** (CMU), "Verification methods of 3-D integrated system," *FCRP Center for Circuit and System Solutions*, USD $116,746, 11/2009–10/2010.
- **Xin Li** (CMU), Ronald Blanton (CMU) and Lawrence Pileggi (CMU), "Statistical models and methods for design and test of non-digital components," *Semiconductor Research Corporation*, USD $150,000, 08/2009–07/2012.
- **Xin Li** (CMU) and Rob Rutenbar (UIUC), "SHF: Small: Virtual probe: a statistically optimal framework for affordable monitoring and tuning of large-scale digital integrated circuits," *National Science Foundation*, USD $450,000, 08/2009–07/2012.
- **Xin Li** (CMU), "CPA-DA: A statistical regression framework for large-scale modeling and optimization of mixed-signal nano circuits," *National Science Foundation*, USD $268,432, 08/2008–07/2011.
- **Xin Li** (CMU), "Efficient statistical analysis for large-scale circuits," *Mentor Graphics Inc.*, USD $65,000, 01/2007–12/2009 (Gift Funding).

Co-principal Investigator, Duke University, Durham, NC, USA

- Yiran Chen (Duke), Robert Calderbank (Duke), Krishnendu Chakrabarty (Duke), Hai Li (Duke) and **Xin Li** (Duke), "Planning IUCRC Duke university: center for alternative sustainable and intelligent computing," *National Science Foundation*, USD $15,000, 09/2017–08/2018.
- Krishnendu Chakrabarty (Duke), **Xin Li** (Duke) and Robert Calderbank (Duke), "Intelligent design, validation, testing and diagnosis of integrated circuits and systems via big data analytics," *Huawei Technologies Corporation*, USD $200,000, 07/2017–06/2018.

Co-principal Investigator, Carnegie Mellon University, Pittsburgh, PA, USA

- Lawrence Pileggi (CMU), **Xin Li** (CMU) and Gabriela Hug (CMU), "Algorithms and software tool for mixed-mode simulation of smart-grid electric power systems," *CMU-SYSU Collaborative Innovation Research Center*, USD $160,000, 03/2015–02/2016.

- Ronald Blanton (CMU), Ken Mai (CMU), Radu Marculescu (CMU), Jeyanandh Paramesh (CMU), Jeff Schneider (CMU), **Xin Li** (CMU), Diana Marculescu (CMU) and Don Thomas (CMU), "SHF: Large: High-performance, low-power, self-evolving integrated systems through statistical learning on chip (SLIC)," *National Science Foundation*, USD $2,237,363, 07/2013–06/2016.
- Ronald Blanton (CMU) and **Xin Li** (CMU), "EAGER: Statistical learning in chip," *National Science Foundation*, USD $300,000, 09/2012–12/2014.
- Tamal Mukherjee (CMU), **Xin Li** (CMU), Rohit Negi (CMU) and Lawrence Pileggi (CMU), "Reconfigurable RF front end programming (RRFEP)," *Defense Advanced Research Projects Agency*, USD $1,083,309, 07/2012–12/2015.
- Gabriela Hug (CMU) and **Xin Li** (CMU), "Planning, management and control in large-scale systems: enabling the integration of intermittent energy sources," *National Science Foundation*, USD $346,215, 09/2010–08/2014.
- Bruce Krogh (CMU) and **Xin Li** (CMU), "Investigation of formal verification methods for self-healing analog/RF systems," *FCRP Center for Circuit and System Solutions*, USD $40,000, 06/2010–10/2010.
- Rob Rutenbar (CMU) and **Xin Li** (CMU), "Virtual probe: efficient statistics for low-cost silicon testing and tuning," *FCRP Center for Circuit and System Solutions*, USD $50,000, 11/2009–10/2010.
- Gary Fedder (CMU), Lawrence Pileggi (CMU), Tamal Mukherjee (CMU) and **Xin Li** (CMU), "Self-healing MEMS filters," *Defense Advanced Research Projects Agency*, USD $277,660, 09/2009–06/2010.
- Lawrence Pileggi (CMU) and **Xin Li** (CMU), "Millimeter-wave autonomic radios (MARS)," *Defense Advanced Research Projects Agency*, USD $960,757, 04/2009–08/2015 (Subcontract from IBM).
- Lawrence Pileggi (CMU) and **Xin Li** (CMU), "Adaptive IC design via stochastic optimization," *National Science Foundation*, USD $312,000, 10/2007–09/2010.
- Lawrence Pileggi (Xigmix) and **Xin Li** (Xigmix), "IC memory characterization, optimization and compilation for SoC design," *The Pittsburgh Technology Collaborative*, USD $80,000, 06/2006–05/2007.

ADVISING ACTIVITIES

Post-doc Supervisor, Carnegie Mellon University, Pittsburgh, PA, USA

1. Yang Liu, 08/2016 – Present
   Project: Big Data Analytics for Advanced Manufacturing
   First Job: TBD
2. Xiaoming Chen, 10/2014 – 07/2016
   Project: Efficient Modeling, Analysis and Optimization for Cyberphysical Systems
   First Job: University of Notre Dame, Notre Dame, Indiana, USA
3. Yiyu Shi, 11/2009 – 04/2010
   Project: Verification Method for 3D Integrated System
   First Job: Missouri University of Science and Technology, Rolla, MO, USA

PhD Advisor, Duke University, Durham, NC, USA

1. Hassan Albalawi, 07/2013 – Present
   Dissertation: TBD
   First Job: TBD

PhD Advisor, Carnegie Mellon University, Pittsburgh, PA, USA

1. Fa Wang, 08/2009 – 12/2015
   Dissertation: Efficient Pre-Silicon Validation and Post-Silicon Tuning of Self-Healing Analog/RF Integrated Circuits
   First Job: Oracle, Denver, CO, USA
2. Shupeng Sun, 08/2010 – 08/2015
   Dissertation: Fast Statistical Analysis of Rare Failure Events for SRAM Circuits in High-Dimensional Variation Space
   First Job: Google, Mountain View, CA, USA
3. Jinyin Zhang, 01/2008 – 08/2013
   Dissertation: Imaging Task-related Neural Activity by MEG Decoding
   First Job: Google, Mountain View, CA, USA

PhD Co-advisor, Carnegie Mellon University, Pittsburgh, PA, USA

1. Nguyen Manh Cuong, co-advised by Prof. Ronald Blanton (CMU), 08/2015 – Present
   Dissertation: TBD
   First Job: TBD
2. Vishwanath Venkata, co-advised by Prof. Aswin Sankaranarayanan (CMU), 08/2014 – Present
   Dissertation: TBD
   First Job: TBD
3. Yang Xue, co-advised by Prof. Ronald Blanton (CMU), 01/2012 – 08/2016
   Dissertation: Physically-Aware Diagnostic Resolution Enhancement for Digital Circuits
   First Job: Agency for Science, Technology and Research, Singapore
4. Hugo Goncalves, co-advised by Prof. Miguel Velhote Correia (FEUP), 08/2010 – 07/2015
   Dissertation: Accelerated Sparse Coding with Overcomplete Dictionaries for Image Processing Applications
   First Job: Synopsys, Porto, Portugal
5. Kyri Baker, co-advised by Prof. Gabriela Hug (CMU), 08/2010 – 12/2014
   Dissertation: Coordination of Resources Across Areas for The Integration of Renewable Generation: Operation, Sizing and Siting of Storage Devices
   First Job: National Renewable Energy Laboratory, Golden, CO, USA
6. Wangyang Zhang, co-advised by Prof. Rob Rutenbar (UIUC), 08/2008 – 09/2012
   Dissertation: IC Spatial Variation Modeling: Algorithms and Applications
   First Job: Cadence Design Systems, Pittsburgh, PA, USA

Visiting Scholar Supervisor, Duke University, Durham, NC, USA

1. Ming Du, 04/2017 – 03/2018
   Project: Big Data Analytics for Health Care
   Affiliation: Donghua University, Shanghai, P. R. China

Visiting Scholar Supervisor, Carnegie Mellon University, Pittsburgh, PA, USA

2. Yuhao Wang, 10/2014 – 08/2015
   Project: On-chip Machine Learning Using Nonvolatile Memory
   Affiliation: Nanyang Technological University, Singapore
3. Wenbin Zhang, 12/2014 – 06/2015
   Project: Spatial Variation Modeling by Compressive Sensing
   Affiliation: Fudan University, Shanghai, P. R. China
4. Po-Hsun Wu, 04/2014 – 04/2015
   Project: Physical Design for Nanoscale Analog Circuits
   Affiliation: National Cheng Kung University, Tainan, Taiwan
5. Jun Tao, 08/2012 – 07/2013
   Project: Design and Optimization for Reconfigurable Analog and Mixed-Signal Systems
   Affiliation: Fudan University, Shanghai, P. R. China

PhD Thesis Committee, Carnegie Mellon University, Pittsburgh, PA, USA

1. Cheng Xue, February 2016
   Dissertation: Optimizing IC Testing for Diagnosability, Effectiveness and Efficiency
2. Katharine Brigham, March 2015
   Dissertation: Robust State Fusers over Long-Haul Sensor Networks with Applications to Target Tracking
3. Da-Cheng Juan, June 2014
   Dissertation: A Learning-Based Framework Incorporating Domain Knowledge for Performance Modeling
4. Soner Yaldiz, January 2012
   Dissertation: Self-Healing Design Methodologies for Analog Integrated Circuits
5. Xiaochun Yu, May 2011
   Dissertation: Controlling IC Quality through Diagnosis Assisted Adaptive Test
6. Seungjune Jeon, December 2010
   Dissertation: Low-Density Parity-Check Codes for Data Storage and Memory Systems
7. Umut Arslan, October 2010
   Dissertation: Concurrent Optimization of Low-Cost Regular Fabrics and Variation-Tolerant Circuit Techniques for Nanoscale SRAM

8. Gokce Keskin, September 2010
   Dissertation: Self-Healing Circuits Using Statistical Element Selection
9. Alyssa Bonnoit, April 2010
   Dissertation: Reducing Power using Body Biasing in Microprocessors with Dynamic Voltage/Frequency Scaling
10. Jian Wang, August 2008
    Dissertation: Response Surface Modeling for Analog and Mixed-Signal Design

PhD Thesis Committee, Michigan Technological University, Houghton, MI, USA
1. Yang Liu, June 2016
   Dissertation: Analysis and Detection of Cyberattacks in Smart Home Cyber-Physical Energy Systems

PhD Thesis Committee, Stony Brook University, Stony Brook, NY, USA
1. Fanshu Jiao, December 2016
   Dissertation: Analog Circuit Design Knowledge Mining and Circuit Causal Information Modeling

PhD Thesis Committee, University of California, Santa Barbara, CA, USA
1. Chun-Kai Hsu, March 2016
   Dissertation: Test Data Analytics: Exploration of Hidden Patterns for Test Cost Reduction and Silicon Characterization

PhD Thesis Committee, University of Illinois at Urbana-Champaign, Champaign, IL, USA
1. Seyed Ahmadyan, October 2016
   Dissertation: Verification, Validation and Optimization of Analog Circuits Using Sampling Algorithms

PhD Thesis Committee, University of Pittsburgh, Pittsburgh, PA, USA
1. Beiye Liu, April 2016
   Dissertation: Neuromorphic System Design and Application

MS Thesis Advisor, Carnegie Mellon University, Pittsburgh, PA, USA
1. Mohamad Baker Alawieh, 08/2014 – 12/2016
   Dissertation: Efficient Hierarchical Performance Modeling for Analog and Mixed-Signal Circuits via Bayesian Co-Learning
2. Shihui Yin, 08/2013 – 05/2015
   Thesis: Efficient Programming of Reconfigurable Radio Frequency (RF) Systems by Convexification
3. Yuanzhe Wang, 08/2011 – 12/2012
   Thesis: Efficient Transient Analysis of Power Delivery Network by Sparse Approximation
4. Huapeng Zhou, 08/2010 – 05/2012
   Thesis: Optimal Temperature Sensor Allocation for Full-Chip Thermal Monitoring
5. Yamei Feng, 08/2010 – 12/2011
   Thesis: Efficient Failure Rate Prediction for SRAM Cells via Gibbs Sampling
6. Changdao Dong, 08/2009 – 05/2011
   Thesis: Efficient SRAM Failure Rate Prediction via Gibbs Sampling
7. Pei Sun, 01/2010 – 05/2011
   Thesis: Efficient Incremental Analysis of On-Chip Power Grid via Sparse Approximation
8. Chenlei Guo, 07/2008 – 05/2009
   Thesis: Efficient and Robust Algorithms for Signal Space Separation

MS Thesis Committee, Carnegie Mellon University, Pittsburgh, PA, USA
1. Megha Sunny, September 2016
   Thesis: Reconfigurable RF Front-End Designs for A Software Defined Radio
2. Mohammadhadi Amini, August 2015
   Thesis: An Aggregated Framework for Electric Vehicle's Charging Demand as Dispatchable Loads and Effects of EVs on Network Loss Minimization

MS Student Project, Duke Kunshan University, Kunshan, Jiangsu, P. R. China
1. Haitian Pang, Summer 2017
   Project: Artificial Intelligence for Industrial Applications
2. Tinghua Chen, Summer 2017

Project: Big Data Analytics for Smart Buildings
3. Handi Yu, Spring 2017
Project: Statistical Validation of Autonomous Driving Systems

MS Student Project, Carnegie Mellon University, Pittsburgh, PA, USA
1. Zhi Liu, Fall 2015
Project: Hardware and Software Implementation for Real-Time Traffic Sign Recognition
2. Ajinkya Bari, Fall 2015
Project: Design and Implementation for In-door Visible Light Positioning
3. Dileep Kadambi, Fall 2015
Project: Design and Implementation for In-door Visible Light Positioning
4. Bernardo Cardoso, Spring 2015
Project: Algorithm and Hardware Implementation for Image Denoising
5. Joao Martins, Spring 2015
Project: Algorithm and Hardware Implementation for Compressive Sensing
6. Anand Bhat, Summer 2014
Project: Hardware System Design for ECG Biometric Authentication
7. Daniel Ting, Spring 2014
Project: Hardware System Design for ECG Biometric Authentication
8. Jiadong Ji, Summer 2012
Project: Movement Decoding for Electrocorticography-Based Brain Computer Interface
9. Xingying Cheng, Spring 2011
Project: Movement Decoding for Magnetoencephalography-Based Brain Computer Interface
10. Ekansh Bhatnagar, Spring 2011
Project: Design and Implementation of Self-Healing Memory Systems
11. Xiaohan Huang, Fall 2010
Project: Brain Mapping Based on Magnetoencephalography Data
12. Qi Mao, Spring 2010
Project: Parallel Programming for Real-Time Neural Signal Processing
13. Shangyi Lin, Summer 2009
Project: Predictive NBTI Modeling of Nanoscale Integrated Circuits
14. Yuchi Cheng, Summer 2009
Project: Parallel Implementation of Numerical Algorithms
15. Chunhan Chen, Spring 2009
Project: Low-Cost Silicon Characterization of Nanoscale Integrated Circuits
16. Yingchang Chen, Spring 2009
Project: Low-Cost Silicon Characterization of Nanoscale Integrated Circuits
17. Shangyi Lin, Fall 2008
Project: Variation Modeling and Analysis of Interconnect Parasitics for Nanoscale IC Technologies

Undergraduate Student Project, Duke Kunshan University, Kunshan, Jiangsu, P. R. China
1. Kaitai Zhang, Summer 2017
Project: Big Data Analytics for Smart Buildings
2. Renjian Pan, Spring 2017
Project: Statistical Modeling and Analysis for Tunable Integrated Circuits

Undergraduate Student Project, Carnegie Mellon University, Pittsburgh, PA, USA
1. Hassan Dbouk, Summer 2016
Project: FPGA Implementation for Computer Vision Algorithms
2. Saurabh Mehta, Summer 2016
Project: Hardware and Software Implementation for Deep Learning
3. Raksha Ravimohan, Summer 2016
Project: Hardware and Software Implementation for Deep Learning
4. Ousama Kanawati, Summer 2015
Project: Hardware and Software Implementation for Real-Time Traffic Sign Recognition
5. Markus Woodson, Spring 2015

Project: Efficient Image Denoising by Block Matching
6. Karen Jung, Fall 2014
Project: Efficient Implementation of High-Speed High-Resolution Image Recording on Smart Phones
7. Yuwei Zhang, Summer 2014
Project: Efficient Performance Extraction for Analog/RF Circuits
8. Siqi Ji, Summer 2014
Project: Efficient Design and Optimization for Tunable Analog Circuits
9. Xiaoxiao Li, Summer 2014
Project: Ultra Low-Power Data Processing of Electrocardiogram Biometrics
10. Ali Ghaddar, Summer 2014
Project: Real-Time Signal Processing for Magnetoencephalography
11. Paolo Cachecho, Summer 2014
Project: Efficient Analog Performance Modeling by Bayesian Model Fusion
12. Aatish Nayak, Spring 2014
Project: Efficient Implementation of Movement Decoding for Brain Computer Interface Using Fixed-Point Arithmetic
13. Ahmed Shalaby, Fall 2013
Project: Hardware System Design for ECG Biometric Authentication
14. Hongyang Zhang, Summer 2013
Project: Modeling and Analysis of High-Speed I/O Links
15. Mohamad Alawieh, Summer 2013
Project: Statistical Optimization for Large-Scale Analog and Digital Circuits
16. Soumya Mittal, Summer 2013
Project: Modeling and Analysis of High-Speed I/O Links
17. Karen Jung, Summer 2013
Project: Efficient Implementation of Linear Equation Solver
18. Alvin Mao, Spring 2013
Project: Efficient Implementation of Movement Decoding for Brain Computer Interface Using Fixed-Point Arithmetic
19. Alyssa Danesh, Fall 2012
Project: Magnetoencephalography Signal Processing and Decoding
20. Jennifer Lee, Summer 2012
Project: Efficient Implementation of Circuit Simulator
21. Martin Gao, Summer 2012
Project: Efficient Implementation of Circuit Simulator
22. Saketh Pothireddy, Fall 2011
Project: Neural Signal Processing for Brain Computer Interface
23. Yubin Niu, Summer 2011
Project: Movement Decoding for Magnetoencephalography-Based Brain Computer Interface
24. Benjamin Niewenhuis, Summer 2011
Project: Robust Design of Nanoscale Memory Circuits
25. Rohit Agarwal, Summer 2011
Project: Movement Decoding for Magnetoencephalography-Based Brain Computer Interface
26. Sanchit Deshmukh, Summer 2011
Project: Robust Design of Nanoscale Memory Circuits
27. Itthi Chatnuntawech, Summer 2010
Project: Low-Cost Frequency Binning for Microprocessor Chips
28. Rajeev Krithivasan, Summer 2010
Project: Parallel Programming for Numerical Computation

UNIVERSITY SERVICE

Duke University, Durham, NC, USA

- 2017 – Present: Member, China Faculty Council

Duke Kunshan University, Kunshan, Jiangsu, P. R. China

- 2017 – Present: Member, Research Policy Committee
- 2017 – Present: Member, Talent Nomination Committee
- 2017 – Present: Member, University Colloquium Committee
- 2017: Member, Review Committee for MS Program on Medical Physics

Carnegie Mellon University, Pittsburgh, PA, USA

- 2014 –2016: Member, ECE Curriculum Review Committee
- 2011 –2016: Member, ECE Undergraduate Advising Committee
- 2010 – 2011: Member, ECE Seminar Organizing Committee
- 2007 –2010: Member, ECE Graduate Studies Committee

OUTREACH ACTIVITIES

- 03/2011: Annual Convention of the National Society of Black Engineers, St. Louis, MO

CONSULTING EXPERIENCE

- 01/2016 – Present: Shandong Yingcai University, Shandong, P. R. China (5 days per year)
- 12/2012 – Present: Fudan University, Shanghai, P. R. China (5 days per year)
- 07/2015 – 07/2017: Singapore Institute of Manufacturing Technology, Singapore (20 days)
- 12/2014 – 01/2015: ShanghaiTech University, Shanghai, P. R. China (20 days)
- 12/2013 – 12/2013: Nanyang Technological University, Singapore (5 days)
- 07/2012 – 08/2012: Intel Corporation, Hillsboro, OR, USA (5 days)
- 05/2009 – 02/2010: Mentor Graphics Inc., Wilsonville, OR, USA (20 days)

PROFESSIONAL MEMBERSHIP

- 2014 – Present: Association for Computing Machinery
  M'14
- 2001 – Present: Institute of Electrical and Electronics Engineers
  S'01-M'06-SM'10

PROFESSIONAL SERVICE

Board of Directors

- 2015 – Present: X&L Holding, Hong Kong, P. R. China
- 2015 – 2017: R&B Smart Devices, Hong Kong, P. R. China

Technical Advisory Board

- 2016 – Present: Fontainburg Capital, Shanghai, P. R. China
- 2009 – 2012: Mentor Graphics Inc., Wilsonville, OR, USA

Committee Chair

- 2015 – 2016: IEEE Council on Electronic Design Automation, Pennsylvania Chapter

Executive Committee

- 2015 – Present: IEEE Technical Committee on Cyber-Physical Systems
- 2015 – Present: ACM Special Interest Group on Design Automation
- 2015 – Present: IEEE Technical Committee on VLSI
- 2015 – 2016: IEEE Council on Electronic Design Automation, Pennsylvania Chapter

Panelist

- 2016 – 2017: National Science Foundation, Arlington, VA, USA
- 2014: National Science Foundation, Arlington, VA, USA
- 2012: National Science Foundation, Arlington, VA, USA

Award Committee

- 2015 – 2016: IEEE TTTC E. J. McCluskey Best Doctoral Thesis
- 2015 – 2016: ACM SIGDA Student Research Competition
- 2016: ACM SIGDA Outstanding PhD Dissertation Award
- 2016: ACM TODAES Best Paper Award
- 2013: ACM SIGDA Outstanding PhD Dissertation in EDA
- 2006: IEEE Outstanding Young Author Award

Journal: Special Content Editor

- 2016 – 2020: Integration, The VLSI Journal

Journal: Associate Editor

- 2016 – Present: IET Cyber-Physical Systems: Theory & Applications
- 2016 – Present: IEEE Trans. on Biomedical Engineering
- 2015 – Present: IEEE Design & Test
- 2014 – Present: ACM Trans. on Design Automation of Electronic Systems
- 2012 – Present: IEEE Trans. on Computer-Aided Design of Integrated Circuits and Systems
- 2011 – Present: Journal of Low Power Electronics

Journal: Guest Editor

- 2016: IET Cyber-Physical Systems: Theory & Applications
- 2016: IEEE Trans. on Big Data
- 2016 – 2017: ACM Journal on Emerging Technologies in Computing Systems
- 2016: IEEE Trans. on Nanotechnology
- 2016: IEEE Trans. on Computer-Aided Design of Integrated Circuits and Systems
- 2015: ACM Trans. on Cyber-Physical Systems
- 2015: Integration, the VLSI Journal
- 2015 – 2017: IEEE Design & Test
- 2015: IEEE Journal on Emerging and Selected Topics in Circuits and Systems

Conference: Steering Committee

- 2017 – Present: Frontiers in Analog Circuit Synthesis and Verification
- 2015 – Present: IEEE International Symposium on Nanoelectronic and Information Systems

Conference: General Chair

- 2017: IEEE International Symposium on Nanoelectronic and Information Systems
- 2016 – 2017: International Workshop on Design Automation for Cyber-Physical Systems

- 2015 – 2016: International Workshop on Hardware and Algorithms for Learning On-a-chip
- 2012 – 2016: International Workshop on Design Automation for Analog and Mixed-Signal Circuits
- 2016: International Workshop on Cross-Layer Cyber-Physical Systems Security
- 2016: IEEE Computer Society Annual Symposium on VLSI
- 2015: Frontiers in Analog Circuit Synthesis and Verification
- 2015: ACM SIGDA PhD Forum at Design Automation Conference
- 2010: International Workshop on Biomedical System Design

Conference: Technical Program Committee Chair

- 2015: International Symposium on Design Technologies for Internet of Things
- 2015: International Conference on Computer-Aided Design and Computer Graphics

Conference: Executive Committee

- 2017 – Present: IEEE/ACM Design Automation Conference
- 2015 – 2016: IEEE International Symposium on Nanoelectronic and Information Systems
- 2015 – 2016: IEEE Computer Society Annual Symposium on VLSI
- 2015 – 2016: IEEE Great Lakes Symposium on VLSI
- 2014 – 2016: ACM SIGDA PhD Forum at Design Automation Conference

Conference: Technical Program Sub-Committee Chair

- 2016: IEEE International Conference on VLSI Design
- 2014: IEEE Computer Society Annual Symposium on VLSI
- 2010 – 2011: IEEE/ACM International Conference on Computer-Aided Design

Conference: Technical Program Committee

- 2017: IEEE Custom Integrated Circuits Conference
- 2016: IEEE International Conference on Computer Design
- 2016 – Present: IEEE/ACM Design Automation Conference
- 2015 – Present: IEEE/ACM International Conference on Computer-Aided Design
- 2015 – 2016: ACM International Workshop on Timing Issues
- 2015 – 2016: IEEE International Conference on VLSI Design
- 2015 – 2017: ACM SIGDA DATE PhD Forum
- 2015 – 2017: ACM SIGDA ASPDAC PhD Forum
- 2014 – 2016: IEEE Computer Society Annual Symposium on VLSI
- 2014 – 2016: ACM SIGDA DAC PhD Forum
- 2013 – Present: Frontiers in Analog Circuit Synthesis and Verification
- 2015: IEEE International Workshop on Test and Validation of High-Speed Analog Circuits
- 2015: IEEE International Conference on Cyber Security and Cloud Computing
- 2015: International Conference on Computer-Aided Design and Computer Graphics
- 2014: IEEE International Test Conference
- 2011 – 2013: IEEE/ACM Design Automation Conference
- 2010 – 2012: ACM International Workshop on Timing Issues
- 2008 – 2011: IEEE/ACM International Conference on Computer-Aided Design
- 2009: IEEE International Conference on VLSI Design

Newsletter: Editor

- 2015 – Present: Newsletter by IEEE Computer Society Technical Committee on VLSI

- 2015 – 2016: Newsletter by IEEE Systems, Man, and Cybernetics Society Technical Committee on Cybernetics for Cyber-Physical Systems

Reviewer: Book

- John Wiley & Sons
- Cambridge University Press

Reviewer: Journal Paper

- ACM Journal on Emerging Technologies in Computing Systems
- ACM Trans. on Design Automation of Electronic Systems
- IEEE Design & Test of Computers
- IEEE Trans. on Biomedical Circuits and Systems
- IEEE Trans. on Biomedical Engineering
- IEEE Trans. on Circuits and Systems - I
- IEEE Trans. on Circuits and Systems - II
- IEEE Trans. on Computer-Aided Design
- IEEE Trans. on Multi-Scale Computing Systems
- IEEE Trans. on Neural Networks and Learning Systems
- IEEE Trans. on Neural Systems and Rehabilitation Engineering
- IEEE Trans. on Semiconductor Manufacturing
- IEEE Trans. on Very Large Scale Integration Systems
- IEEE Journal on Emerging and Selected Topics in Circuits and Systems
- IEEE Signal Processing Letters
- IET Circuits, Devices & Systems
- International Journal of Circuit Theory and Application
- Integration, the VLSI Journal
- Journal of Low Power Electronics
- Journal of Neural Engineering

Reviewer: Conference Paper

- IEEE/ACM Design Automation Conference
- IEEE/ACM International Conference on Computer-Aided Design
- IEEE/ACM Design, Automation & Test in Europe
- IEEE/ACM Great Lakes Symposium on VLSI
- IEEE International Symposium on Circuits and Systems

INVITED TALKS

1. **Xin Li**, "Big data analytics: practices and applications," *Huawei Technologies* (Suzhou, Jiangsu, P. R. China), Aug. 2017.
2. **Xin Li**, "Big data technology: recent trends and new applications," *ITValue Summit* (Sanya, Hainan, P. R. China), Jul. 2017.
3. **Xin Li**, "Making automobile smart and safe by design automation," *System Level Interconnect Prediction Workshop* (Austin, TX), Jun. 2017.
4. **Xin Li**, "Making automobile smart and safe by big data analysis," *Singapore Institute of Manufacturing Technology* (Singapore), Jun. 2017.
5. **Xin Li**, "Data analytics for complex systems: from circuit design to brain analysis," *Institute of Computing Technology, Chinese Academy of Sciences* (Beijing, P. R. China), Jun. 2017.
6. **Xin Li**, "Big data analytics: practices and applications," *Singapore Institute of Manufacturing Technology* (Singapore), Nov. 2016.

7. **Xin Li**, "Efficient statistical validation of machine learning systems for autonomous driving," *Cadence Design Systems Inc.* (San Jose, CA), Nov. 2016.
8. **Xin Li**, "Data analytics for complex systems: from circuit design to brain analysis," *Texas A&M University* (College Station, TX), Nov. 2016.
9. **Xin Li**, "Efficient statistical validation of machine learning systems for autonomous driving," *International Conference on Computer-Aided Design* (Austin, TX), Nov. 2016.
10. **Xin Li**, "Big data analytics: practices and applications," *Huawei Technologies* (Shanghai, P. R. China), Oct. 2016.
11. **Xin Li**, "Efficient statistical validation of machine learning systems for autonomous driving," *International Conference on Solid-State and Integrated Circuit Technology* (Hangzhou, P. R. China), Oct. 2016.
12. **Xin Li**, "Algorithms and hardware for learning on-a-chip: design, integration and validation," *Embedded Systems Week.* (Pittsburgh, PA), Oct. 2016.
13. **Xin Li**, "Machine learning for emerging engineering applications: circuit, brain and automobile," *Cadence Design Systems Inc.* (Beijing, P. R. China), Aug. 2016.
14. **Xin Li**, "Big data analytics: practices and applications," *R&B Technology Group* (Shanghai, P. R. China), Jul. 2016.
15. **Xin Li**, "Efficient statistical validation of machine learning systems for autonomous driving," *ShanghaiTech Workshop on Emerging Devices, Circuits and Systems* (Shanghai, P. R. China), Jul. 2016.
16. **Xin Li**, "Machine learning for emerging engineering applications: circuit, brain and automobile," *Cadence Design Systems Inc.* (Shanghai, P. R. China), Jun. 2016.
17. **Xin Li**, "Big data analytics: practices and applications," *Foxconn Technology Group* (Shenzhen, Guangdong, P. R. China), May. 2016.
18. **Xin Li**, "Machine learning for emerging engineering applications: circuit, brain and automobile," *General Motors Company* (Detroit, MI), May. 2016.
19. **Xin Li**, "Data analytics for complex systems: from circuit design to brain analysis," *Duke University* (Durham, NC), May. 2016.
20. **Xin Li**, "Data analytics for complex systems: from circuit to brain," *University of Illinois at Urbana-Champaign* (Champaign, IL), Apr. 2016.
21. **Xin Li**, "Big data analytics for semiconductor manufacturing," *Foxconn Technology Group* (New Taipei, Taiwan), Mar. 2016.
22. **Xin Li**, "Machine learning for emerging engineering applications: circuit, brain and automobile," *Cadence Design Systems Inc.* (San Jose, CA), Feb. 2016. (**Cadence Distinguished Speaker Series**)
23. **Xin Li**, "Machine learning for emerging engineering applications: circuit, brain and automobile," *University of California, San Diego* (San Diego, CA), Jan. 2016.
24. **Xin Li**, "Microelectronics research in post-Moore era: circuit, brain and automobile," *Intel Corporation* (Hillsboro, OR), Dec. 2015.
25. **Xin Li**, "Fast statistical analysis of rare circuit failure events for memory circuits in high-dimensional variation space," *Sandia National Laboratories* (Albuquerque, NM), Dec. 2015.
26. **Xin Li**, "Microelectronics research in post-Moore era: circuit, brain and automobile," *University of Illinois at Urbana-Champaign* (Champaign, IL), Dec. 2015.
27. **Xin Li**, "Big data analytics in manufacturing processes," *Singapore Institute of Manufacturing Technology* (Singapore), Nov. 2015.
28. **Xin Li**, "Self-healing of analog/RF circuits: a statistical approach," *Singapore Institute of Manufacturing Technology* (Singapore), Nov. 2015.
29. **Xin Li**, "Variability analysis and optimization for analog and mixed-signal circuits: challenges and opportunities," *International Workshop on Variability Modeling and Characterization* (Austin, TX), Nov. 2015.
30. **Xin Li**, "From robust chip to smart building: CAD algorithms and methodologies for uncertainty analysis of building performance," *International Conference on Computer-Aided Design* (Austin, TX), Nov. 2015.
31. **Xin Li**, "Machine learning for emerging engineering applications: circuit, brain and automobile," *Duke University* (Durham, NC), Oct. 2015.
32. **Xin Li**, "Statistical modeling: from VLSI CAD to brain imaging," *Peking University* (Beijing, P. R. China), Sep. 2015.
33. **Xin Li**, "Self-healing of analog/RF circuits: a statistical approach," *Xi'an Jiaotong University* (Xi'an, Shaanxi, P. R. China), Aug. 2015.
34. **Xin Li**, "From robust chip to smart building: CAD algorithms and methodologies for uncertainty analysis of building performance," *International Symposium on Design Technologies for Internet of Things* (Shenzhen, Guangdong, P. R. China), Aug. 2015.
35. **Xin Li**, "Self-healing of analog/RF circuits: a statistical approach," *Peking University* (Shenzhen, Guangdong, P. R. China), Aug. 2015.
36. **Xin Li**, "Academia-industry collaboration: a matching game," *Design Automation Conference* (San Francisco, CA), Jun.

2015.

37. **Xin Li**, "Self-healing of analog/RF circuits: a statistical approach," *CMOS Emerging Technologies Research Conference* (Vancouver, BC, Canada), May. 2015.
38. **Xin Li**, "Fast statistical analysis of rare failure events for memory circuits in high-dimensional variation space," *Asia and South Pacific Design Automation Conference* (Chiba, Japan), Jan. 2015.
39. **Xin Li**, "Self-healing of analog/RF circuits: a statistical approach," *Shanghai Jiaotong University* (Shanghai, P. R. China), Dec. 2014.
40. **Xin Li**, "Ultra-low-power biomedical circuit design and optimization: catching the don't cares," *International Symposium on Integrated Circuits* (Singapore), Dec. 2014.
41. **Xin Li**, "Virtual probe: a statistical framework for low-cost variability characterization of nanoscale integrated circuits," *Sun Yat-sen University* (Guangzhou, Guangdong, P. R. China), Oct. 2014.
42. **Xin Li**, "Big data analytics in small data world: efficient post-silicon validation/tuning of AMS circuits via Bayesian model fusion," *International Test Conference* (Seattle, WA), Oct. 2014.
43. **Xin Li**, "Virtual probe: a statistical framework for low-cost variability characterization of nanoscale integrated circuits," *ShanghaiTech University* (Shanghai, P. R. China), Sep. 2014.
44. **Xin Li**, "Virtual probe: a statistical framework for low-cost variability characterization of nanoscale integrated circuits," *Shanghai Jiaotong University* (Shanghai, P. R. China), Sep. 2014.
45. **Xin Li**, "Adding resilient RF circuits to software-defined radio," *International Workshop on Cross-layer Resiliency* (Marina del Rey, CA), Jul. 2014.
46. **Xin Li**, "Bayesian model fusion: big-data analysis of integrated circuit manufacturing by recycling historical information," *Singapore Institute of Manufacturing Technology* (Singapore), Jul. 2014.
47. **Xin Li**, "Virtual probe: a statistical framework for low-cost variability characterization of nanoscale integrated circuits," *University of South Florida* (Tampa, FL), Jul. 2014.
48. **Xin Li**, "Virtual probe: a statistical framework for low-cost variability characterization of nanoscale integrated circuits," *Singapore Institute of Manufacturing Technology* (Singapore), Jun. 2014.
49. **Xin Li**, "Virtual probe: a statistical framework for low-cost variability characterization of nanoscale integrated circuits," *Peking University* (Beijing, P. R. China), Jun. 2014.
50. **Xin Li**, "Virtual probe: a statistical framework for low-cost variability characterization of nanoscale integrated circuits," *Tsinghua University* (Beijing, P. R. China), Jun. 2014.
51. **Xin Li**, "Efficient SRAM failure rate analysis for nanoscale IC technology: theory and implementation," *Fudan University* (Shanghai, P. R. China), May. 2014.
52. **Xin Li**, "Decoding hand movement from magnetoencephalographic brain computer interfaces: challenges and solutions," *ShanghaiTech University* (Shanghai, P. R. China), Nov. 2013.
53. **Xin Li**, "Bayesian model fusion: a statistical framework for efficient pre-silicon validation and post-silicon tuning of complex analog and mixed-signal circuits," *Fudan University* (Shanghai, P. R. China), Nov. 2013.
54. **Xin Li**, "Bayesian model fusion: a statistical framework for efficient pre-silicon validation and post-silicon tuning of complex analog and mixed-signal circuits," *International Conference on Computer-Aided Design* (San Jose, CA), Nov. 2013.
55. **Xin Li**, "Virtual probe: a statistical framework for low-cost variability characterization of nanoscale integrated circuits," *Intel Corporation* (Santa Clara, CA), Nov. 2013.
56. **Xin Li**, "Modeling and self-healing of analog/RF circuits: a statistical approach," *International Workshop on Test and Validation of High Speed Analog Circuits* (Anaheim, CA), Sep. 2013.
57. **Xin Li**, "Virtual probe: a statistical framework for low-cost variability characterization of nanoscale integrated circuits," *Fudan University* (Shanghai, P. R. China), Jul. 2013.
58. **Xin Li**, "Decoding hand movement from magnetoencephalographic brain computer interfaces: challenges and solutions," *National University of Singapore* (Singapore), Jul. 2013.
59. **Xin Li**, "Virtual probe: a statistical framework for low-cost variability characterization of nanoscale integrated circuits," *Nanyang Technological University* (Singapore), Jul. 2013.
60. **Xin Li**, "Modeling and self-healing of analog/RF circuits: a statistical approach," *International Workshop on Self-Healing Mixed-Signal Circuitry: Built-in Calibration and Compensation Techniques* (Seattle, WA), Jun. 2013.
61. **Xin Li**, "Virtual probe: a statistical framework for low-cost variability characterization of nanoscale integrated circuits," *Peking University* (Shenzhen, Guangdong, P. R. China), Dec. 2012.
62. **Xin Li**, "Movement decoding for brain computer interface," *Fudan University* (Shanghai, P. R. China), Dec. 2012.
63. **Xin Li**, "Modeling and self-healing of analog and mixed-signal integrated circuits: a statistical approach," *Frontiers of Information Science and Technology* (Shanghai, P. R. China), Dec. 2012.
64. **Xin Li**, "Movement decoding for brain computer interface," *Zhejiang University* (Hangzhou, Zhejiang, P. R. China), Dec. 2012.

65. **Xin Li**, "Post-silicon performance modeling and tuning of analog/mixed-signal circuits via Bayesian model fusion," *International Conference on Computer-Aided Design* (San Jose, CA), Nov. 2012.
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Institute of Acoustics, Chinese Academy of Sciences Beijing, China
Master of Engineering in Signal and Information Processing 2005-2008
ThinkIT Speech Laboratory
Advisor: Yonghong Yan

Nanjing University Nanjing, China
Bachelor of Science in Telecommunications engineering 2001-2005
Graduate with the highest honor
Rank: top1 within 50 students in communication engineering major

INDUSTRY

Qualcomm Corporate R&D San Diego, USA
Summer Intern 2011 summer

My current research interests:

My research interests lie in the areas of multimodal signal processing, speech and language processing, machine learning, statistical modeling, affective computing, structure health monitoring. My work is to enhance the robustness and efficiency of the multimodal human state recognition tasks which cover a broad range of applications, notably in security, healthcare and user assistance. Multimodal human state recognition can be considered as a task encompassing term for identifying or verifying various kinds of human centered state labels from multimodal signals, both overtly expressed and covertly present. We can also use signal processing and machine learning techniques for structure health monitoring.

Human state recognition:

1. **Speech signal processing**: Speech recognition, speaker verification, spoken language identification, speech paralinguistics detection, speaker diarization, emotion recognition, array signal processing, speech enhancement

2. Human behavior signal processing: gathering, analyzing and modeling multimodal human behavior signals, both overtly and covertly expressed (speech/language/audio/visual/physiological signal analysis and understanding)

3. **Multimodal biometrics:** Audio-visual joint biometrics, emerging behavior biometrics (ECG biometrics), finger biometrics, iris biometrics, multimodal fusion

4. **Body sensing, processing and modeling methods in metabolic health monitoring**: Multimodal physical activity recognition, energy efficient sensing and modeling

Teaching:

Teaching J1799d Design Implementation of Speech Recognition Systems (CMU ECE 18799 SP TPC SIGNL PROCSNG Section GD, Fall14, Fall15, Spring15, Fall16)

Teaching J1782 Pattern Recognition (Spring17)

Teaching EIT467 Applied Probability Theory (Fall17)

Funding:

- PI of project “A study of text independent paralinguistic speech attribute recognition based on the end-to-end deep learning framework”, Natural Science Foundation of China, 2018-2021, 600K RMB.

- PI of project “Robust speaker verification based on multiple phonetic level deep features and discriminative subspace modeling”, Natural Science Foundation of Guangzhou City, 2018-2020, 200K RMB.

- PI of project “A study of key speech processing technologies for security applications”, funded by SYSU, 2017, 500K RMB.

- PI of project “Robust human computer interaction based on speech processing and microphone array technology” funded by JRI, 2017.1~2017.12, 1M RMB.

- PI of project “speaker verification and language identification and voice conversion technology", funded by Jinlin Tech, 2016.1-2016.8, 2.89M RMB.

- PI of project “design and implementation of speech recognition systems course", funded by SYSU excellent graduate course foundation, 2016-2017, 60K RMB.

- PI of project “A speech analysis system for high education classroom interaction using speech processing technology ", funded by SYSU network center, 2016-2017, 100K RMB.

- PI of NSFC project “Speaker recognition and language recognition using articulatory information in the speech production system and mid-level discriminative tokenization”, 2015.1~2017.12, 280K RMB.

- PI of NSFC-Guangdong project “Robust short duration text dependent speaker verification”, 2015.1~2017.12, 100K RMB.

- PI of the project, “Speech information retrieval for targeting Chinese dialects and foreign languages” funded by Fundamental Research Funds for the Central Universities, 2015.7~2017.6, 500K RMB.

- PI of project “Multimodal human behavior signal analysis for autism kids", funded by IBM, 2016.1-2016.12, 100K RMB.

- PI of project “text dependent speaker verification", funded by BAIDU, 2015.6-2015.12, 196K RMB.

- PI of project “Multimodal human behavior modeling through computational sensing and analysis for young children with autism spectrum disorders” funded by JRI, 2013.9~2016.9, 1M RMB.

- Co-PI of project, “Study and Industrialization of video big data content analysis systems for education cloud based on intelligent speech and audio processing technologies”, funded by Guangdong enterprises-universities-researches integration foundation, 2018-2020, 1M RMB (total), 300K RMB (subcontract, SYSU part).

- Co-PI of project, “Whole body PET/MRI imaging system”, funded by National Key Research and Development Program, 2016-2020, 10M RMB (total), 150K RMB (SYSU part).

- Co-PI of innovation team project “Structure health monitoring for plates and pipes using ultrasound techniques” funded by JRI, 2014,1~2016.12, 5M RMB (total).

- Co-PI of project “Algorithm and Hardware Co-Design for Ultra Low-Power Data Processing of Electrocardiogram (ECG) Biometrics” funded by CMU-SYSU Collaborative Innovation Research Center at Carnegie Mellon University, 2014-2015, 100K USD.

- Co-PI of project “Affect Analysis in Human-Human Interactions” funded by CMU-SYSU Collaborative Innovation Research Center at Carnegie Mellon University, 2015-2016, 100K USD.

PUBLICATIONS

Journal papers:

1) Kong-Yik Chee; Zhe Jin; Danwei Cai; **Ming Li**; Wun-She Yap; Yen-Lung Lai; Bok-Min Goi, “Cancellable Speech Template via Random Binary Orthogonal Matrices Projection Hashing,” submitted to Pattern Recognition, minor revision, 2017.
2) Zhicheng Li, Yinliang Xu, **Ming Li (*)**, “Finite-time Stability and Stabilization of Semi-Markovian Jump Systems with Time Delay”, submitted to International Journal of Robust and Nonlinear Control, minor revision, 2017.
3) Wenbo Zhao, **Ming Li (*),** Joel B. Harley, Yuanwei Jin, Jos e M.F. Moura, Jimmy Zhu, "Reconstruction of Lamb wave dispersion curves by sparse representation and continuity constraints", Journal of the Acoustical Society of America, 2017.
4) Wenbo Liu, **Ming Li** (*), Li Yi, "Identifying Children with Autism Spectrum Disorder Based on Their Face Processing Abnormality: A Machine Learning framework", Autism research, 2016.
5) Yinliang Xu, Zaiyue Yang, Wei Gu, **Ming Li,** and Zicong Deng, "Robust Real-Time Distributed Optimal Control Based Energy Management in a Smart Grid", IEEE TRANSACTIONS ON SMART GRID, 2015.
6) Donna Spruijt-Metz, Cheng K.F. Wen, Gillian O’Reilly, **Ming Li**, Sangwon Lee, Adar Emken, Urbashi Mitra, Murali Annavaram, Gisele Ragusa, Shrikanth Narayanan. “Innovations in the Use of Interactive Technology to Support Weight Management”, Current Obesity Reports. 2015
7) **Ming Li(*)**, Jangwon Kim, Adam Lammert, Prasanta Kumar Ghosh, Vikram Ramanarayanan, Shrikanth Narayanan, “Speaker verification based on the fusion of speech acoustics and inverted articulatory signals”, Computer Speech & Language, 2015.
8) **Ming Li (*)**and Wenbo Liu, "Generalized I-vector Representation with Phonetic Tokenizations and Tandem Features for both Text Independent and Text Dependent Speaker Verification", Journal of Signal Processing Systems, 2015.

9) **Ming Li(*)**, and Shrikanth Narayanan. "Simplified Supervised I-vector Modeling and Sparse Representation with application to Robust Language Recognition", Computer Speech & Language, 2014.
10) **Ming Li(*)**, Kyu J. Hanb and Shrikanth Narayanan, "Automatic Speaker Age and Gender Recognition using acoustic and prosodic level information fusion", Computer speech and language, 2013, vol 27.
11) Daniel Bone, **Ming Li**, Matthew P. Black and Shrikanth S. Narayanan. "Intoxicated Speech Detection: A Fusion Framework with Speaker-Normalized Hierarchical Functionals and GMM Supervectors." Computer Speech & Language, 2013.
12) Jangwon Kim, Naveen Kumar, Andreas Tsiartas, **Ming Li**, Shrikanth S. Narayanan, "Automatic intelligibility classification of sentence-level pathological speech", to appear in Computer Speech & Language.
13) U. Mitra, A. Emken, S. Lee, **M. Li,** V. Rozgic, G. Thatte, H. Vathsangam, D. Zois, M. Annavaram, S. Narayanan, D. Spruijt-Metz, and G. Sukhatme, "KNOWME: a Case Study in Wireless Body Area Sensor Network Design", IEEE Communications Magazine 2012 50:5(116-125).
14) Gautam Thatte, **Ming Li**, Sangwon Lee, Adar Emken, Shri Narayanan, Urbashi Mitra, Donna Spruijt-Metz and Murali Annavaram, "KNOWME: An Energy-Efficient and Multimodal Body Area Sensing System for Physical Activity Monitoring," ACM Transactions in Embedded Computing Systems, 2012.
15) Adar Emken, **Ming Li**, Gautam Thatte, Sangwon Lee, Murali Annavaram, Urbashi Mitra, Shrikanth Narayanan, Donna Spruijt-Metz, "Recognition of Physical Activities in Overweight Hispanic Youth using KNOWME Networks", Journal of Physical Activity and Health, 9:3(432-441) 2012.
16) Gautam Thatte, **Ming Li**, Sangwon Lee, Adar Emken, Murali Annavaram, Shri Narayanan, Donna Spruijt-Metz, Urbashi Mitra, "Optimal Time-Resource Allocation for Energy-Efficient Physical Activity Detection", IEEE Transaction on Signal Processing, vol 59, issue 4, April, 2011.
17) **Ming Li(*),** Viktor Rozgic, Gautam Thatte, Sangwon Lee, Adar Emken, Murali Annavaram, Urbashi Mitra, Donna Spruijt-Metz and Shrikanth Narayanan, "Multimodal Physical Activity Recognition by Fusing Temporal and Cepstral Information," IEEE Transactions on Neural Systems & Rehabilitation Engineering, vol 18, issue 4, August, 2010.
18) Hongbin Suo, **Ming Li**, Ping Lu, Yonghong Yan, "Automatic language identification with discriminative language characterization based on SVM", IEICE transaction on Information and Systems, 2008.
19) Hongbin Suo, **Ming Li,** Ping Lu, Yonghong Yan, "Using SVM as back-end classifier for language identification", EURASIP Journal on Audio, Speech, and Music Processing, 2008.
20) Jianping Zhang, **Ming Li,** Hongbin Suo, Lin Yang, Qiang Fu and Yonghong Yan, "Long span prosodic features for speaker recognition", ACTA ACOUSTICA, 2010. (In chinese)

Conference papers:

1) **Ming Li,** Luting Wang, Zhicheng Xu, Danwei Cai, "Mandarin Electrolaryngeal Voice Conversion with Combination of Gaussian Mixture Model and Non-negative Matrix Factorization", APSIPA ASC 2017.
2) Tianyan Zhou, Yixiang Xie, Xiaobing Zou, **Ming Li(*)**，"An Automated Assessment Framework for Speech Abnormalities related to Autism Spectrum Disorder", ASMMC 2017.
3) Jing Pan, **Ming Li**(*), Zhanmei Song, Xin Li, Xiaolin Liu, Hua Yi and Manman Zhu,"An audio based piano performance evaluation method using deep neural network based acoustic modeling", Interspeech 2017.
4) Weicheng Cai, Danwei Cai, Wenbo Liu, Gang Li**, Ming Li**(*), "Countermeasures for Automatic Speaker Verification Replay Spoofing Attack : On Data Augmentation, Feature Representation, Classification and Fusion", Interspeech 2017.
5) Danwei Cai, Zhidong Ni, Wenbo Liu, Weicheng Cai, Gang Li**, Ming Li**(*), "End-to-End Deep Learning Framework for Speech Paralinguistics Detection Based on Perception Aware Spectrum", Interspeech 2017.
6) Jinkun Chen, **Ming Li**(*), "Automatic Emotional Spoken Language Text Corpus Construction from Written Dialogs in Fictions", ACII 2017.
7) Wenbo Liu, Xiaobin Zou, **Ming Li**(*), "RESPONSE TO NAME: A DATASET AND A MULTIMODAL MACHINE LEARNING FRAMEWORK TOWARDS AUTISM STUDY", ACII 2017.
8) Weiyang Liu, Yandong Wen, Zhiding Yu, **Ming Li**, Bhiksha Raj, Le Song, "SphereFace: Deep Hypersphere Embedding for Face Recognition", CVPR 2017.

9) Tianyan Zhou, Weicheng Cai, Huadi Zheng, Luting Wang, Xiaoyan Chen,Xiaobing Zou, Shilei Zhang, **Ming Li**(*), "A Pitch, Energy and Phoneme Duration Features based Speaker Diarization System for Autism Kids' Real-Life Audio Data", ISCSLP 2016.
10) Danwei Cai, Weicheng Cai, **Ming Li**(*), "Locality Sensitive Discriminant Analysis for Speaker Recognition", APSIPA ASC 2016.
11) Gaoyuan He, Jinkun Chen, Xuebo Liu, and **Ming Li**(*), "The SYSU System for CCPR 2016 Multimodal Emotion Recognition Challenge", CCPR 2016.
12) Huadi Zheng, Weicheng Cai, Tianyan Zhou, Shilei Zhang, **Ming Li**(*), "Text-Independent Voice Conversion Using Deep Neural Network Based Phonetic Level Features", ICPR 2016.
13) Wei Fang, Jianwen Zhang, Dilin Wang, Zheng Chen, **Ming Li**, Entity Disambiguation by Knowledge and Text Jointly Embedding, CONLL 2016.
14) Yandong Wen, Weiyang Liu, Meng Yang, **Ming Li**, "Efficient Misalignment-robust Face Recognition via Locality-constrained Representation", ICIP 2016.
15) Zhun Chen, Wenbo Zhao, Yuanwei Jin, **Ming Li**(*), Jimmy Zhu, "A Fast Tracking Algorithm for Estimating Ultrasonic Signal Time of Flight in Drilled Shafts Using Active Shape Models", IEEE International Ultrasonics Symposium 2016.
16) Zhiding Yu, Weiyang Liu, Wenbo Liu, Yingzhen Yang, **Ming Li** and Vijayakumar Bhagavatula, "On Order-Constrained Transitive Distance Clustering", AAAI, 2016.
17) Shushan Chen, Yiming Zhou and **Ming Li**(*), "Automatic English Pronunciation Evaluation System", APSIPA ASC 2015.
18) Shitao Weng, Shushan Chen, Lei Yu, Xuewei Wu, Weicheng Cai, Zhi Liu, Yiming Zhou and **Ming Li**(*), "THE SYSU SYSTEM FOR THE INTERSPEECH 2015 AUTOMATIC SPEAKER VERIFICATION SPOOFING AND COUNTERMEASURES CHALLENGE", APSIPA ASC 2015.
19) Wenbo Liu, Zhiding Yu, Li Yi, Bhiksha Raj, **Ming Li**(*), "Efficient Autism Spectrum Disorder Diagnosis with Eye Movement: A Machine Learning Framework", ACII 2015.
20) Wenbo Liu, Zhiding Yu, Bhiksha Raj and **Ming Li**(*), "Locality Constrained Transitive Distance Clustering on Speech Data", INTERSPEECH 2015.
21) Qingyang Hong, Lin Li, **Ming Li**, Ling Huang, Lihong Wan and Jun Zhang,"Modified-prior PLDA and Score Calibration for Duration Mismatch Compensation in Speaker Recognition System", INTERSPEECH 2015.
22) Weicheng Cai, **Ming Li**(*), Lin Li and Qingyang Hong,"Duration Dependent Covariance Regularization in PLDA Modeling for Speaker Verification", INTERSPEECH 2015.
23) Yingxue Wang, Shenghui Zhao, Wenbo liu, **Ming Li,** Jingming Kuang, "Speech bandwidth extension based on Deep Neural Networks", INTERSPEECH 2015.
24) **Ming Li**, "speaker verification with the mixture of Gaussian factor analysis based representation", ICASSP 2015.
25) Wenbo Liu, Zhiding Yu and **Ming Li**(*)**,** "An Iterative Framework for Unsupervised Learning in the PLDA basedSpeaker Verification", ISCSLP 2014.
26) **Ming Li**, Wenbo Liu, "Speaker verification and spoken language identification using a generalized i-vector framework with phonetic tokenization and tandem features", INTERSPEECH 2014.
27) **Ming Li**, "Automatic recognition of speaker physical load using posterior probability based features from acoustic and phonetic tokens", INTERSPEECH 2014.
28) Prashanth Gurunath Shivakumar, **Ming Li**, Vedant Dhandhania and Shrikanth S.Narayanan, "SIMPLIFIED AND SUPERVISED I-VECTOR MODELING FOR SPEAKER AGE REGRESSION", ICASSP 2014.
29) **Ming Li**, Xin Li, "verification based ECG biometrics with cardiac irregular conditions using heartbeat level and segment level information fusion", ICASSP 2014.
30) **Ming Li**, Andreas Tsiartas, Maarten Van Segbroeck and Shrikanth S. Narayanan, "SPEAKER VERIFICATION USING SIMPLIFIED AND SUPERVISED I-VECTOR MODELING", ICASSP 2013.
31) **Ming Li,** Adam Lammert, Jangwon Kim, Prasanta Ghosh and Shrikanth Narayanan, "Automatic Classification of Palatal and PharyngealWall Morphology Patterns from Speech Acoustics and Inverted Articulatory Signals", Workshop on Speech Production in Automatic Speech Recognition, 2013.
32) **Ming Li**, Jangwon Kim, Prasanta Kumar Ghosh, Vikram Ramanarayanan and Shrikanth Narayanan, "Speaker

verification based on fusion of acoustic and articulatory information", Interspeech 2013.

33) Andreas Tsiartas, Theodora Chaspari, Nassos Katsamanis, Prasanta Ghosh, **Ming Li,** Maarten Van Segbroeck, Alexandros Potamianos, Shrikanth Narayanan, "Multi-band long-term signal variability features for robust voice activity detection", Interspeech 2013.
34) Kyu Jeong Han, Sriram Ganapathy, **Ming Li,** Mohamed K. Omar and Shrikanth S. Narayanan, "TRAP Language Identification System for RATS Phase II Evaluation", Interspeech 2013.
35) Daniel Bone, Theodora Chaspari, Kartik Audhkhasi, James Gibson, Andreas Tsiartas, Maarten Van Segbroeck, **Ming Li,** Sungbok Lee and Shrikanth S. Narayanan, "Classifying Language-Related Developmental Disorders from Speech Cues: the Promise and the Potential Confounds", Interspeech 2013.
36) **Ming Li**, Charley Lu, Anne Wang, Shrikanth Narayanan, "Speaker Verification using Lasso based Sparse Total Variability Supervector and Probabilistic Linear Discriminant Analysis", presented at NIST Speaker Recognition Workshop, Atlanta, 2011.published in Proceedings of APSIPA Annual Summit and Conference, Hollywood, CA, 2012
37) **Ming Li**, Angeliki Metallinou, Daniel Bone, Shrikanth Narayanan, "Speaker states recognition using latent factor analysis based Eigenchannel factor vector modeling", ICASSP 2012.
38) Jangwon Kim, Naveen Kumar, Andreas Tsiartas, **Ming Li** and Shrikanth S. Narayanan, "Intelligibility classification of pathological speech using fusion of multiple high level descriptors", Interspeech 2012.
39) Kartik Audhkhasi, Angeliki Metallinou, **Ming Li** and Shrikanth S. Narayanan, "Speaker Personality Classification Using Systems Based on Acoustic-Lexical Cues and an Optimal Tree-Structured Bayesian Network", Interspeech 2012.
40) **Ming Li,** Xiang Zhang, Yonghong Yan and Shrikanth Narayanan, "Speaker Verification using Sparse Representations on Total Variability I-Vectors,", Interspeech Florence, Italy, 2011.
41) **Ming Li**, Shrikanth Narayanan, "Robust talking face video verification using joint factor analysis and sparse representation on GMM mean shifted supervectors", ICASSP, Prague, Czech Republic, 2011.
42) Samuel Kim, **Ming Li**, Sangwon Lee, Urbashi Mitra, Adar Emken, Donna Spruijt-Metz, Murali Annavaram, Shrikanth Narayanan, "Modeling high-level descriptions of real-life physical activities using latent topic modeling of multimodal sensor signals", IEEE conference of engineering in medicine and biology society (EMBC), Boston, 2011.
43) Daniel Bone, Matthew P. Black**, Ming Li,** Angeliki Metallinou, Sungbok Lee and Shrikanth Narayanan, "Intoxicated Speech Detection by Fusion of Speaker Normalized Hierarchical Features and GMM Supervectors", Interspeech, Florence, Italy, 2011.
44) **Ming Li**, Shrikanth Narayanan, "ECG Biometrics by Fusing Temporal and Cepstral Information", 20th conference of the International Association for Pattern Recognition, ICPR 2010, Turkey.
45) **Ming Li**, Chi-Sang Jung and Kyu Jeong Han, "Combining Five Acoustic Level methods for Automatic Speaker Age and Gender Recognition",Interspeech, 2010.
46) Gautam Thatte, Viktor Rozgic, **Ming Li,** Sabyasachi Ghosh, Urbashi Mitra, Shri Narayanan, Murali Annavaram, Donna Spruijt-Metz, "Optimal Time-Resource Allocation for Activity-Detection via Multimodal Sensing," in Proceedings of the Fourth International Conference on Body Area Networks (BodyNets), Los Angeles, CA, 2009.
47) Gautam Thatte, Viktor Rozgic, **Ming Li**, Sabyasachi Ghosh, Urbashi Mitra, Shri Narayanan, Murali Annavaram and Donna Spruijt-Metz, "Optimal Allocation of Time-Resources for Multihypothesis Activity-Level Detection," in Proceedings of the 5th IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS), Marina Del Rey, CA (June 2009). (Best paper award!)
48) Sangwon Lee, Murali Annavaram, Gautam Thatte, Vikor Rozgic, **Ming Li**, Urbashi Mitra, Shri Narayanan and Donna Spruijt-Metz, "Sensing for Obesity: KNOWME Implementation and Lessons for an Architect," in Proceedings of the Workshop on Biomedicine in Computing: Systems, Architectures, and Circuits (BiC2009), Austin, TX (June 2009).
49) Gautam Thatte, **Ming Li**, Adar Emken, Urbashi Mitra, Shri Narayanan, Murali Annavaram and Donna Spruijt-Metz, "Energy-Efficient Multihypothesis Activity-Detection for Health-Monitoring Applications," the 31st Annual International Conference of the IEE Engineering in Medicine and Biology Society (EMBC), Minneapolis, 2009.
50) **Ming Li**, Chuan Cao, Di Wang, Ping Lu, Qiang Fu, and Yonghong Yan, "Cochannel speech separation using multi-pitch estimation and model based voiced sequential grouping", proceeding of International Conference on Spoken Language Processing, INTERSPEECH 2008.
51) **Ming Li**, Hongbin Suo, Xiao Wu, Ping Lu, Yonghong Yan, "Spoken Language Identification Using Score Vector

Modeling and Support Vector Machine", INTERSPEECH 2007.

52) **Ming Li,** Yun Lei, Xiang Zhang, Jian Liu, Yonghong Yan, "authentication and quality monitoring based audio watermark for analog AM shortwave broadcasting", proceeding of IEEE International Conference on Intelligent Information Hiding and Multimedia Signal Processing，IIH-MSP 2007.
53) Hongbin Suo, **Ming Li**, Tantan Liu, Ping Lu, Yonghong Yan,"The Design of Backend Classifiers in PPRLM System for Language Identification", proceeding of International Conference on Natural Computation, ICNC 2007.
54) Hongbin Suo**, Ming Li**, Ping Lu, Yonghong Yan, "Language identification based on parallel PRLM system", proceeding of Chinese national conference on network security, 2007 (in Chinese).
55) **Ming Li**, Yun Lei, Jian Liu, Yonghong Yan, "A Novel Audio Watermarking in Wavelet Domain", proceeding of IEEE International Conference on Intelligent Information Hiding and Multimedia Signal Processing，IIH-MSP 2006.

Awards:

2016 IBM Faculty Award

Works co-authored with his colleagues have won awards at Body Computing Slam Contest 2009, IEEE DCOSS 2009, ISCSLP 2014 best paper, Interspeech2011-Speaker State Challenge and Interspeech2012-Speaker Trait Challenge. He was also featured in the Nov 2013 issue of the Science magazine.

Area Chair

INTERSPEECH 2016, INTERSPEECH 2018

Technical Committee of APSIPA speech, language, audio (SLA) track

Reviewer

IEEE Transactions on Audio, Speech and Language Processing
IEEE Transactions on Information Forensics and Security
IEEE Computational Intelligence Magazine
IEEE Transactions on Emerging Topics in Computing
IEEE Transaction on Affective Computing
IEEE Transactions on Pattern Analysis and Machine Intelligence
EEE Journal of Biomedical and Health Informatics
IEEE Signal Processing Letter
Speech Communication (Elsevier)
Computer Speech and Language (Elsevier)
Integrated Computer-Aided Engineering
EURASIP Journal on Audio Speech and Music Processing
Journal of Systems and Software (Elsevier)
Health and Technology
International Journal of Nanomedicine
Expert Systems With Applications (Elsevier)

9.3. Financial Projections

Enclosed please find three financial documents:

- Budget for the baseline scenario
- Budget for the worst-case scenario
- Summary for the cost of attendance

DKU ECE MEng Program SUMMARY *2 October 2017*

Program Launch at DKU | *2nd Year DKU Students at Duke, tuition paid to DKU* | *Breakeven Year* | *Steady Sate & Breakeven Cumulatively*

	DKU PROGRAM SUMMARY	FY 17/18	FY 18/19		FY 19/20		FY 20/21		FY 21/22		FY 22/23		FY 23/24		FY 24/25		FY 25/26		
	TUITION		%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	**TOTAL**
	1st Year Enrollment at **DKU**			-		25		40		65		90		100		100		100	**520**
	2nd Year Enrollment at **DUKE**			-		-		25		40		65		90		100		100	**420**
	Total Enrollment			**-**		**25**		**65**		**105**		**155**		**190**		**200**		**200**	**940**
YR 1 Students	***PRC***																		
	Enrollment	-	90%	-	90%	23	94%	38	94%	61	94%	85	94%	94	94%	94	94%	94	**489**
	Tuition	-		25,641		25,641		25,641		25,641		25,641		25,641		25,641		25,641	
	Tuition Revenue	-		-		589,744		974,359		1,564,103		2,179,487		2,410,256		2,410,256		2,410,256	**12,538,462**
	Aid	-	10%	-	10%	(58,974)	10%	(97,436)	10%	(156,410)	10%	(217,949)	10%	(241,026)	10%	(241,026)	10%	(241,026)	**(1,253,846)**
	Net-Tuition	**-**		**-**		**530,769**		**876,923**		**1,407,692**		**1,961,538**		**2,169,231**		**2,169,231**		**2,169,231**	**11,284,615**
	International																		
	Enrollment	-	10%	-	10%	2	6%	2	6%	4	6%	5	6%	6	6%	6	6%	6	**31**
	Tuition	-		49,560		49,560		49,560		49,560		49,560		49,560		49,560		49,560	
	Tuition Revenue	-		-		99,120		99,120		198,240		247,800		297,360		297,360		297,360	**1,536,360**
	Aid	-	50%	-	50%	(49,560)	50%	(49,560)	50%	(99,120)	50%	(123,900)	50%	(148,680)	50%	(148,680)	50%	(148,680)	**(768,180)**
	Net-Tuition	**-**		**-**		**49,560**		**49,560**		**99,120**		**123,900**		**148,680**		**148,680**		**148,680**	768,180
	1ST YEAR ENROLLMENT	**-**		-		**25**		**40**		**65**		**90**		**100**		**100**		**100**	**520**
	1ST YEAR TUITION REVENUE	**-**		**-**		**688,864**		**1,073,479**		**1,762,343**		**2,427,287**		**2,707,616**		**2,707,616**		**2,707,616**	**14,074,822**
	1ST YEAR AID	**-**		**-**		**(108,534)**		**(146,996)**		**(255,530)**		**(341,849)**		**(389,706)**		**(389,706)**		**(389,706)**	**(2,022,026)**
	1ST YEAR NET TUITION	**0**		**0**		**580,329**		**926,483**		**1,506,812**		**2,085,438**		**2,317,911**		**2,317,911**		**2,317,911**	**12,052,795**
YR 2 Students	***PRC***																		
	Enrollment				90%	-	90%	23	94%	38	94%	61	94%	85	94%	94	94%	94	**395**
	Enrollment (4 semesters)				67%	-	67%	15	67%	25	67%	41	67%	57	67%	63	67%	63	**264**
	Enrollment (3+ semesters)				33%	-	33%	8	33%	13	33%	20	33%	28	33%	31	33%	31	**131**
	Tuition (4 semesters)				67%	25,641	67%	25,641	67%	25,641	67%	25,641	67%	25,641	67%	25,641	67%	25,641	
	Tuition (3+ semesters)				33%	12,821	33%	12,821	33%	12,821	33%	12,821	33%	12,821	33%	12,821	33%	12,821	
	Tuition (+3 credits for 4th semester)				33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	
	Tuition Revenue					-		556,179		919,817		1,480,192		2,062,013		2,280,196		2,280,196	**9,578,593**
	Aid				10%	-	10%	(55,618)	10%	(91,982)	10%	(148,019)	10%	(206,201)	10%	(228,020)	10%	(228,020)	**(957,859)**
	Net-Tuition					**-**		**500,562**		**827,836**		**1,332,173**		**1,855,812**		**2,052,176**		**2,052,176**	**8,620,734**
	International																		
	Enrollment				10%	-	10%	2	6%	2	6%	4	6%	5	6%	6	6%	6	**19**
	Enrollment (4 semesters)				67%	-	67%	1	67%	1	67%	3	67%	3	67%	4	67%	4	**12**
	Enrollment (3+ semesters)				33%	-	33%	1	33%	1	33%	1	33%	2	33%	2	33%	2	**7**
	Tuition (4 semesters)				67%	49,560	67%	49,560	67%	49,560	67%	49,560	67%	49,560	67%	49,560	67%	49,560	
	Tuition (3+ semesters)				33%	24,780	33%	24,780	33%	24,780	33%	24,780	33%	24,780	33%	24,780	33%	24,780	
	Tuition (+3 credits for 4th semester)				33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	
	Tuition Revenue					-		82,965		82,965		182,085		215,490		265,050		265,050	**1,093,605**
	Aid				50%	-	50%	(41,483)	50%	(41,483)	50%	(91,043)	50%	(107,745)	50%	(132,525)	50%	(132,525)	**(546,803)**
	Net-Tuition					**-**		**41,483**		**41,483**		**91,043**		**107,745**		**132,525**		**132,525**	546,803
	2ND YEAR ENROLLMENT					**-**		**25**		**40**		**65**		**90**		**100**		**100**	**420**
	2ND YEAR TUITION REVENUE					**-**		**639,144**		**1,002,782**		**1,662,277**		**2,277,503**		**2,545,246**		**2,545,246**	**10,672,198**
	2ND YEAR AID					**-**		**(97,100)**		**(133,464)**		**(239,062)**		**(313,946)**		**(360,545)**		**(360,545)**	**(1,504,662)**
	2ND YEAR NET TUITION					**0**		**542,044**		**869,318**		**1,423,216**		**1,963,557**		**2,184,701**		**2,184,701**	**9,167,536**
	TOTAL DKU ENROLLMENT	**-**		**-**		**25**		**65**		**105**		**155**		**190**		**200**		**200**	**940**
	TOTAL DKU TUITION REVENUE	**-**		**-**		**688,864**		**1,712,623**		**2,765,125**		**4,089,564**		**4,985,119**		**5,252,862**		**5,252,862**	**24,747,019**
	TOTAL YEAR AID	**-**		**-**		**(108,534)**		**(244,096)**		**(388,994)**		**(580,910)**		**(703,652)**		**(750,250)**		**(750,250)**	**(3,526,688)**
	TOTAL NET TUITION	**-**		**-**		**580,329**		**1,468,527**		**2,376,130**		**3,508,654**		**4,281,467**		**4,502,612**		**4,502,612**	**21,220,332**

DKU PROGRAM EXPENSES

	FY 17/18	FY 18/19	FY 19/20	FY 20/21	FY 21/22	FY 22/23	FY 23/24	FY 24/25	FY 25/26	TOTAL
Compensation & Benefits	(18,750)	120,500	315,086	440,297	604,508	768,719	807,719	807,719	807,719	**4,653,517**
Allowances	22,500	145,286	85,571	270,857	321,429	361,714	216,714	206,429	185,857	**1,816,357**
Other Operating Expenses	-	70,000	120,000	117,000	97,000	97,000	47,000	47,000	47,000	**642,000**
Program Expenses	-	20,000	50,000	80,000	130,000	180,000	200,000	200,000	200,000	**1,060,000**
Program Support Fee to Duke	*Placeholder. TBD.*			100% 542,044	100% 869,318	100% 1,423,216	100% 1,963,557	100% 2,184,701	100% 2,184,701	**9,167,536**
Service Fees W/H Taxes	-	-	1,913	1,913	1,913	1,913	1,913	1,913	1,913	**13,388**
TOTAL	**3,750**	**355,786**	**572,570**	**1,452,111**	**2,024,167**	**2,832,561**	**3,236,902**	**3,447,761**	**3,427,190**	**17,352,798**
CONTRIBUTION MARGIN	**(3,750)**	**(355,786)**	**7,759**	**16,416**	**351,963**	**676,093**	**1,044,565**	**1,054,851**	**1,075,422**	**3,867,534**
CUMULATIVE CM	**(3,750)**	**(359,536)**	**(351,776)**	**(335,360)**	**16,603**	**692,696**	**1,737,261**	**2,792,112**	**3,867,534**	

The PRC Year 2 tuition differential of $22,694 will be paid to Pratt directly by the student through the Study Away Fee. With the steady state enrollment of 94 PRC students this amounts to $2.25M.

DKU ECE MEng Program DETAILS

2 October 2017

2017 Constant Dollars

			FY 17/18	FY 18/19	FY 19/20	FY 20/21	FY 21/22	FY 22/23	FY 23/24	FY 24/25	FY 25/26	TOTAL
ENROLLMENT AT DKU			-	-	25	40	65	90	100	100	100	
Compensation for named staff are included in totals but are hidden to keep salary confidential.												
Staff paid by DKU thru Duke												
Director of Applied Physical Sciences & Eng Program			50%	50%	50%	50%	50%	50%	50%	50%	50%	
Fall - David Brady			-	-	0%	0%	0%	0%	0%	0%	0%	
Spring - A&S Math Faculty			-	-	15,000	15,000	15,000	15,000	15,000	15,000	15,000	
Duke Fringe Benefits												
Staff paid by DKU *(rates are fully loaded with social benefits, supplemental insurance, retirement and other benefits)*												
Marketing & Recruiting Manager		81,000		100% 81,000	100% 81,000	100% 81,000	100% 81,000	100% 81,000	100% 81,000	100% 81,000	100% 81,000	
Program Coordinator		48,000		0% -	100% 48,000	100% 48,000	100% 48,000	100% 48,000	100% 48,000	100% 48,000	100% 48,000	
Admin Support (shared position with another program)		43,000		0% -	50% 21,500	50% 21,500	50% 21,500	50% 21,500	50% 21,500	50% 21,500	50% 21,500	
New DKU Faculty (assistant professor)		154,000		50% 77,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	
New DKU Faculty (assistant professor)		154,000				50% 77,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	
New DKU Faculty (assistant professor)		154,000					50% 77,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	
New DKU Faculty (assistant professor)		154,000						50% 77,000	100% 154,000	100% 154,000	100% 154,000	
Teaching Assistants		43,711			1 43,711	2 87,422	3 131,133	4 174,844	4 174,844	4 174,844	4 174,844	
Language Instructor (for 90% of the PRC students)		85,000			50% 42,500	100% 85,000	150% 127,500	200% 170,000	200% 170,000	200% 170,000	200% 170,000	
Lab Facility Manager (shared with another program)		49,000		0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	
Overhead collected from research awards (25% of direct cost)		150,000	(18,750)	(37,500)	(56,250)	(75,000)	(112,500)	(150,000)	(168,750)	(168,750)	(168,750)	**(956,250)**
Credit from UG Program for 25% of the teaching costs					(38,500)	(57,750)	(96,250)	(134,750)	(154,000)	(154,000)	(154,000)	
Total Compensation & Benefits			**(18,750)**	**120,500**	**315,086**	**440,297**	**604,508**	**768,719**	**807,719**	**807,719**	**807,719**	**4,653,517**
Allowances												
Administrative Supplement	Director	25,000	12,500	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	**212,500**
Travel	Director	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	**90,000**
Relocation	Faculty	10,000		10,000	-	10,000	10,000	10,000	-	-	-	**40,000**
Housing (4 years)	Faculty	20,571	-	10,286	20,571	30,857	51,429	61,714	61,714	51,429	30,857	**318,857**
Discretionary Fund	Faculty	10,000	-	5,000	10,000	15,000	25,000	35,000	40,000	40,000	40,000	**210,000**
Education Allowance ($10k/sem/child/2 max))	Faculty	40,000	-	10,000	20,000	30,000	50,000	70,000	80,000	80,000	80,000	**420,000**
Start-Up Support	Faculty	150,000	-	75,000	-	150,000	150,000	150,000	-	-	-	**525,000**
Total Allowances			**22,500**	**145,286**	**85,571**	**270,857**	**321,429**	**361,714**	**216,714**	**206,429**	**185,857**	1,816,357
Other Operating Expenses	**Unit**	**Cost**										
Program contingency to recruit faculty			-	-	50,000	50,000	50,000	50,000	-	-	-	**200,000**
Fall & Spring Faculty from Duke (shared w/UG)	per person	4,000	- -	- -	1 4,000	1 4,000	1 4,000	1 4,000	1 4,000	1 4,000	1 4,000	**28,000**
Fly-In Visiting Faculty (visa & medical)	per person	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	**-**
Fly-In Visiting TAs (visa & medical)	per person	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	**-**
Visa/Work Permit - Long Term	per person	3,000		-	3,000	-	-					**3,000**
Web Development for DKU presence and maintenance			-	10,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	**31,000**
Student Recruiting & Marketing (in China)			-	40,000	40,000	40,000	20,000	20,000	20,000	20,000	20,000	**220,000**
Student Recruiting & Marketing (outside China)			-	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	**80,000**
Contingency to cover unanticipated expenses				10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	**80,000**
Total Other Operating Expenses			**-**	**70,000**	**120,000**	**117,000**	**97,000**	**97,000**	**47,000**	**47,000**	**47,000**	**642,000**
Program Expenses												
Server for Lab			-	20,000								**20,000**
Instructional Costs (at DKU only)	per student	1,000	-		25,000	40,000	65,000	90,000	100,000	100,000	100,000	**520,000**
Other (at DKU only)	per student	1,000	-		25,000	40,000	65,000	90,000	100,000	100,000	100,000	**520,000**
Total Program Expenses			**-**	**20,000**	**50,000**	**80,000**	**130,000**	**180,000**	**200,000**	**200,000**	**200,000**	**1,060,000**
Program Support Fee to Duke (100% of 2nd Year Net Tuition)* - TBD			-	-	-	100% 542,044	100% 869,318	100% 1,423,216	100% 1,963,557	100% 2,184,701	100% 2,184,701	**9,167,536**
**Contribution to Pratt Overhead*												
Subtotal for Service Fee (on Duke incurred expenses only)			-	-	19,125	19,125	19,125	19,125	19,125	19,125	19,125	
Service Fee W/H Taxes			-	-	1,913	1,913	1,913	1,913	1,913	1,913	1,913	**13,388**
TOTAL PROGRAM EXPENSES			**3,750**	**355,786**	**572,570**	**1,452,111**	**2,024,167**	**2,832,561**	**3,236,902**	**3,447,761**	**3,427,190**	**17,352,798**

Pratt School of Engineering
DKU ECE Masters Program
Duke-Based Financial Analysis

			FY16/17		FY17/18		FY18/19		FY19/20		FY20/21		FY21/22		FY22/23		FY23/24		FY24/25		FY25/26		FY26/27	Total
Student Enrollment			0		0		0		0		25		40		65		90		100		100		100	
REVENUE																								
Revenue (Program Support Fee from DKU)			$0		$0		$0		$0		$542,044		$869,318		$1,423,216		$1,963,557		$2,184,701		$2,184,701		$2,184,701	$11,352,237
Revenue (Study Away Fee)	0%	$22,694	$0		$0	$22,694	$0	$22,694	$0	$22,694	$567,350	$22,694	$907,760	$22,694	$1,475,110	$22,694	$2,042,460	$22,694	$2,269,400	$22,694	$2,269,400	$22,694	$2,269,400	$11,800,880
Total Revenue			**$0**		**$0**		**$0**		**$0**		**$1,109,394**		**$1,777,078**		**$2,898,326**		**$4,006,017**		**$4,454,101**		**$4,454,101**		**$4,454,101**	**$23,153,117**
30% Return to Department	30%		$0		$0		$0		$0		$332,818		$533,123		$869,498		$1,201,805		$1,336,230		$1,336,230		$1,336,230	$6,945,935
70% Maintained by School	70%		$0		$0		$0		$0		$776,576		$1,243,955		$2,028,828		$2,804,212		$3,117,871		$3,117,871		$3,117,871	$16,207,182
Total Revenue			**$0**		**$0**		**$0**		**$0**		**$1,109,394**		**$1,777,078**		**$2,898,326**		**$4,006,017**		**$4,454,101**		**$4,454,101**		**$4,454,101**	**$23,153,117**
EXPENSES																								
Pratt Faculty Expenses																								
Xin Li	50.0%	$175,000	$43,750	2.5%	$89,688	2.5%	$91,930	2.5%	$94,228	2.5%	$96,584	2.5%	$98,998	2.5%	$101,473	2.5%	$104,010	2.5%	$106,610	2.5%	$109,276	2.5%	$112,007	$1,048,553
POP #1	100.0%	$105,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$52,500	2.5%	$107,625	2.5%	$110,316	2.5%	$113,074	2.5%	$115,900	2.5%	$118,798	2.5%	$121,768	$739,980
T/TT#1	100.0%	$175,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$87,500	2.5%	$179,375	2.5%	$183,859	2.5%	$188,456	2.5%	$193,167	2.5%	$197,996	$1,030,354
POP #2	100.0%	$110,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$55,000	2.5%	$112,750	2.5%	$115,569	2.5%	$118,458	$401,777
T/TT#2	100.0%	$180,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$180,000	2.5%	$184,500	$364,500
Fringe Benefits		26.5%	$11,594	27.5%	$24,664	27.5%	$25,281	27.5%	$25,913	27.5%	$40,998	27.5%	$80,884	27.5%	$107,570	27.5%	$125,384	27.5%	$144,022	27.5%	$197,123	27.5%	$202,051	$985,483
Start Up			$0		$0		$0		$0		$150,000		$150,000		$0		$150,000		$0		$150,000		$0	$600,000
Relocation			$10,000		$0		$0		$0		$10,000		$10,000		$0		$10,000		$0		$10,000		$0	$50,000
Recruitment Expenses			$0		$0		$0		$0		$5,000		$5,000		$0		$5,000		$0		$5,000		$0	$20,000
Subtotal			$65,344		$114,352		$117,210		$120,141		$355,082		$540,007		$498,734		$746,327		$667,738		$1,078,932		$936,780	$5,240,647
Other Faculty Expenses																								
Contract with Fuqua		$25,000	$0		$0		$0		$0		$25,000		$25,000		$50,000		$75,000		$125,000		$150,000		$150,000	$600,000
Subtotal			$0		$0		$0		$0		$25,000		$25,000		$50,000		$75,000		$125,000		$150,000		$150,000	$600,000
Staff Expenses																								
DMSA	100%	$50,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$25,000	2.5%	$25,000	2.5%	$52,531	2.5%	$53,845	2.5%	$55,191	2.5%	$56,570	2.5%	$57,985	$326,122
Lab Manager	50%	$60,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$30,000	2.5%	$30,750	2.5%	$31,519	2.5%	$32,307	2.5%	$33,114	2.5%	$33,942	2.5%	$34,791	$226,423
TA		$2,500	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%	$15,000	0.0%	$25,000	0.0%	$40,000	0.0%	$65,000	0.0%	$90,000	0.0%	$100,000	0.0%	$100,000	$435,000
Career Services Advisor	100%	$50,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$25,000	2.5%	$25,625	2.5%	$52,531	2.5%	$53,845	2.5%	$55,191	2.5%	$56,570	2.5%	$57,985	$326,747
Fringe Benefits		26.5%	$0	27.5%	$0	27.5%	$0	27.5%	$0	27.5%	$22,000	27.5%	$22,378	27.5%	$37,560	27.5%	$38,499	27.5%	$39,461	27.5%	$40,448	27.5%	$41,459	$241,805
Subtotal			$0		$0		$0		$0		$117,000		$128,753		$214,141		$243,495		$272,957		$287,531		$292,219	$1,556,096
Language Program																								
Instruction	3%	$1,850	$0	$1,906	$0	$1,963	$0	$2,022	$0	$2,082	$52,055	$2,145	$85,786	$2,209	$143,585	$2,275	$204,774	$2,344	$234,352	$2,414	$241,383	$2,486	$248,625	$1,210,560
Subtotal			$0		$0		$0		$0		$52,055		$85,786		$143,585		$204,774		$234,352		$241,383		$248,625	$1,210,560
Instructional Costs		$1,000	$0		$0		$0		$0		$25,000		$40,000		$65,000		$90,000		$100,000		$100,000		$100,000	$520,000
Other Costs		$1,000	$0		$0		$0		$0		$25,000		$40,000		$65,000		$90,000		$100,000		$100,000		$100,000	$520,000
Subtotal			$0		$0		$0		$0		$50,000		$80,000		$130,000		$180,000		$200,000		$200,000		$200,000	$1,040,000
Total Expenses			**$65,344**		**$114,352**		**$117,210**		**$120,141**		**$599,136**		**$859,547**		**$1,036,460**		**$1,449,596**		**$1,500,048**		**$1,957,846**		**$1,827,624**	**$9,647,303**
Surplus/(Deficit)			($65,344)		($114,352)		($117,210)		($120,141)		$510,258		$917,532		$1,861,866		$2,556,421		$2,954,053		$2,496,255		$2,626,477	$13,505,815

DKU ECE MEng Program SUMMARY - Worst Case Scenario

As of 2 October 2017

Program Launch at DKU | *2nd Year DKU Students at Duke, tuition paid to DKU* | *Breakeven Year* | *Steady Sate & Breakeven Cumulatively*

	DKU PROGRAM SUMMARY	FY 17/18	FY 18/19		FY 19/20		FY 20/21		FY 21/22		FY 22/23		FY 23/24		FY 24/25		FY 25/26		
	TUITION		%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	**TOTAL**
	1st Year Enrollment at **DKU**			-		5		15		25		35		50		50		50	**230**
	2nd Year Enrollment at **DUKE**			-		-		5		15		25		35		50		50	**180**
	Total Enrollment			**-**		**5**		**20**		**40**		**60**		**85**		**100**		**100**	**410**
YR 1 Students	***PRC***																		
	Enrollment	-	90%	-	90%	5	94%	14	94%	24	94%	33	94%	47	94%	47	94%	47	**217**
	Tuition	-		25,641		25,641		25,641		25,641		25,641		25,641		25,641		25,641	
	Tuition Revenue	-		-		128,205		358,974		615,385		846,154		1,205,128		1,205,128		1,205,128	**5,564,103**
	Aid	-	10%	-	10%	(12,821)	10%	(35,897)	10%	(61,538)	10%	(84,615)	10%	(120,513)	10%	(120,513)	10%	(120,513)	**(556,410)**
	Net-Tuition	**-**		**-**		**115,385**		**323,077**		**553,846**		**761,538**		**1,084,615**		**1,084,615**		**1,084,615**	**5,007,692**
	International																		
	Enrollment	-	10%	-	10%	-	6%	1	6%	1	6%	2	6%	3	6%	3	6%	3	**13**
	Tuition	-		49,560		49,560		49,560		49,560		49,560		49,560		49,560		49,560	
	Tuition Revenue	-		-		-		49,560		49,560		99,120		148,680		148,680		148,680	**644,280**
	Aid	-	50%	-	50%	-	50%	(24,780)	50%	(24,780)	50%	(49,560)	50%	(74,340)	50%	(74,340)	50%	(74,340)	**(322,140)**
	Net-Tuition	**-**		**-**		**-**		**24,780**		**24,780**		**49,560**		**74,340**		**74,340**		**74,340**	**322,140**
	1ST YEAR ENROLLMENT	**-**		**-**		**5**		**15**		**25**		**35**		**50**		**50**		**50**	**230**
	1ST YEAR TUITION REVENUE	**-**		**-**		**128,205**		**408,534**		**664,945**		**945,274**		**1,353,808**		**1,353,808**		**1,353,808**	**6,208,383**
	1ST YEAR AID	**-**		**-**		**(12,821)**		**(60,677)**		**(86,318)**		**(134,175)**		**(194,853)**		**(194,853)**		**(194,853)**	**(878,550)**
	1ST YEAR NET TUITION	**0**		**0**		**115,385**		**347,857**		**578,626**		**811,098**		**1,158,955**		**1,158,955**		**1,158,955**	**5,329,832**
YR 2 Students	***PRC***																		
	Enrollment				90%	-	90%	5	94%	14	94%	24	94%	33	94%	47	94%	47	**170**
	Enrollment (4 semesters)				67%	-	67%	3	67%	9	67%	16	67%	22	67%	31	67%	31	**112**
	Enrollment (3+ semesters)				33%	-	33%	2	33%	5	33%	8	33%	11	33%	16	33%	16	**58**
	Tuition (4 semesters)				67%	25,641	67%	25,641	67%	25,641	67%	25,641	67%	25,641	67%	25,641	67%	25,641	
	Tuition (3+ semesters)				33%	12,821	33%	12,821	33%	12,821	33%	12,821	33%	12,821	33%	12,821	33%	12,821	
	Tuition (+3 credits for 4th semester)				33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	
	Tuition Revenue					-		119,814		337,997		581,821		800,003		1,138,000		1,138,000	**4,115,635**
	Aid				10%	-	10%	(11,981)	10%	(33,800)	10%	(58,182)	10%	(80,000)	10%	(113,800)	10%	(113,800)	**(411,563)**
	Net-Tuition					**-**		**107,833**		**304,197**		**523,638**		**720,003**		**1,024,200**		**1,024,200**	**3,704,071**
	International																		
	Enrollment				10%	-	10%	-	6%	1	6%	1	6%	2	6%	3	6%	3	**7**
	Enrollment (4 semesters)				67%	-	67%	-	67%	1	67%	1	67%	1	67%	2	67%	2	**5**
	Enrollment (3+ semesters)				33%	-	33%	-	33%	-	33%	-	33%	1	33%	1	33%	1	**2**
	Tuition (4 semesters)				67%	49,560	67%	49,560	67%	49,560	67%	49,560	67%	49,560	67%	49,560	67%	49,560	
	Tuition (3+ semesters)				33%	24,780	33%	24,780	33%	24,780	33%	24,780	33%	24,780	33%	24,780	33%	24,780	
	Tuition (+3 credits for 4th semester)				33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	33%	8,625	
	Tuition Revenue					-		-		49,560		49,560		82,965		132,525		132,525	**447,135**
	Aid				50%	-	50%	-	50%	(24,780)	50%	(24,780)	50%	(41,483)	50%	(66,263)	50%	(66,263)	**(223,568)**
	Net-Tuition					**-**		**-**		**24,780**		**24,780**		**41,483**		**66,263**		**66,263**	**223,568**
	2ND YEAR ENROLLMENT					**-**		**5**		**15**		**25**		**35**		**50**		**50**	**180**
	2ND YEAR TUITION REVENUE					**-**		**119,814**		**387,557**		**631,381**		**882,968**		**1,270,525**		**1,270,525**	**4,562,770**
	2ND YEAR AID					**-**		**(11,981)**		**(58,580)**		**(82,962)**		**(121,483)**		**(180,063)**		**(180,063)**	**(635,131)**
	2ND YEAR NET TUITION					**0**		**107,833**		**328,977**		**548,418**		**761,485**		**1,090,463**		**1,090,463**	**3,927,639**
	TOTAL DKU ENROLLMENT	**-**		**-**		**5**		**20**		**40**		**60**		**85**		**100**		**100**	**410**
	TOTAL DKU TUITION REVENUE	**-**		**-**		**128,205**		**528,348**		**1,052,501**		**1,576,654**		**2,236,776**		**2,624,333**		**2,624,333**	**10,771,152**
	TOTAL YEAR AID	**-**		**-**		**(12,821)**		**(72,659)**		**(144,898)**		**(217,137)**		**(316,336)**		**(374,915)**		**(374,915)**	**(1,513,681)**
	TOTAL NET TUITION	**-**		**-**		**115,385**		**455,690**		**907,603**		**1,359,517**		**1,920,441**		**2,249,418**		**2,249,418**	**9,257,471**

DKU PROGRAM EXPENSES

	FY 17/18	FY 18/19	FY 19/20	FY 20/21	FY 21/22	FY 22/23	FY 23/24	FY 24/25	FY 25/26	TOTAL
Compensation & Benefits	95,602	232,063	384,149	405,399	465,649	590,860	590,860	590,860	590,860	**3,946,298**
Allowances	22,500	220,286	85,571	85,571	270,857	125,857	115,571	115,571	105,286	**1,147,071**
Other Operating Expenses	-	120,000	70,000	67,000	97,000	47,000	51,000	51,000	51,000	**554,000**
Program Expenses	-	20,000	10,000	30,000	50,000	70,000	100,000	100,000	100,000	**480,000**
Program Support Fee to Duke	*Placeholder. TBD.*			100% 107,833	100% 328,977	100% 548,418	100% 761,485	100% 1,090,463	100% 1,090,463	**3,927,639**
Service Fees W/H Taxes	-	-	1,913	1,913	1,913	1,913	1,913	1,913	1,913	**13,388**
TOTAL	**118,102**	**592,348**	**551,632**	**697,715**	**1,214,395**	**1,384,048**	**1,620,829**	**1,949,806**	**1,939,520**	**10,068,395**
CONTRIBUTION MARGIN	**(118,102)**	**(592,348)**	**(436,248)**	**(242,026)**	**(306,792)**	**(24,531)**	**299,612**	**299,612**	**309,898**	**(810,924)**
CUMULATIVE CM	**(118,102)**	**(710,450)**	**(1,146,698)**	**(1,388,723)**	**(1,695,515)**	**(1,720,046)**	**(1,420,434)**	**(1,120,822)**	**(810,924)**	

The PRC Year 2 tuition differential of $22,694 will be paid to Pratt directly by the student through the Study Away Fee. With the steady state enrollment of 47 PRC students this amounts to $1.12M.

DKU ECE MEng Program DETAILS - Worst Case Scenario

As of 2 October 2017

2017 Constant Dollars

Compensation for named staff are included in totals but are hidden to keep salary confidential.

			FY 17/18	FY 18/19	FY 19/20	FY 20/21	FY 21/22	FY 22/23	FY 23/24	FY 24/25	FY 25/26	TOTAL
ENROLLMENT AT DKU			-	-	5	15	25	35	50	50	50	
Staff paid by DKU thru Duke												
Director of Applied Physical Sciences & Eng Program			50%	50%	50%	50%	50%	50%	50%	50%	50%	789,688
Fall - Pratt Faculty			-	-	0%	0%	0%	0%	0%	0%	0%	-
Spring - A&S Math Faculty			-	-								105,000
Duke Fringe Benefits												246,039
Staff paid by DKU *(rates are fully loaded with social benefits, supplemental insurance, retirement and other benefits)*												
Marketing & Recruiting Manager		81,000		100% 81,000	100% 81,000	100% 81,000	100% 81,000	100% 81,000	100% 81,000	100% 81,000	100% 81,000	**648,000**
Program Coordinator		48,000		0% -	100% 48,000	100% 48,000	100% 48,000	100% 48,000	100% 48,000	100% 48,000	100% 48,000	**336,000**
Admin Support (shared position with another program)		43,000		0% -	50% 21,500	50% 21,500	50% 21,500	50% 21,500	50% 21,500	50% 21,500	50% 21,500	**150,500**
New DKU Faculty (assistant professor)		154,000		50% 77,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	**1,155,000**
New DKU Faculty (assistant professor)		154,000				0% -	50% 77,000	100% 154,000	100% 154,000	100% 154,000	100% 154,000	**693,000**
New DKU Faculty (assistant professor)		154,000					0% -	0% -	0% -	0% -	0% -	**-**
New DKU Faculty (assistant professor)		154,000					0% -	0% -	0% -	0% -	0% -	**-**
Teaching Assistants		43,711			1 43,711	1 43,711	1 43,711	2 87,422	2 87,422	2 87,422	2 87,422	**480,821**
Language Instructor (for 90% of the PRC students)		85,000			0% -	25% 21,250	50% 42,500	100% 85,000	100% 85,000	100% 85,000	100% 85,000	**403,750**
Lab Facility Manager (shared with another program)		49,000		0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	**-**
Overhead collected from research awards (25% of direct cost)		150,000	(18,750)	(37,500)	(56,250)	(56,250)	(75,000)	(93,750)	(93,750)	(93,750)	(93,750)	**(618,750)**
Credit from UG Program for 25% of the teaching costs (Duke & DKU Faculty)					(38,500)	(38,500)	(57,750)	(77,000)	(77,000)	(77,000)	(77,000)	**(442,750)**
Total Compensation & Benefits			**95,602**	**232,063**	**384,149**	**405,399**	**465,649**	**590,860**	**590,860**	**590,860**	**590,860**	**3,946,298**
Allowances												
Administrative Supplement	Director	25,000	12,500	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	**212,500**
Travel	Director	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	**90,000**
Relocation	Faculty	10,000		10,000	-	-	10,000	-	-	-	-	**20,000**
Housing	Faculty	20,571	-	10,286	20,571	20,571	30,857	30,857	20,571	20,571	10,286	**164,571**
Discretionary Fund	Faculty	10,000	-	5,000	10,000	10,000	15,000	20,000	20,000	20,000	20,000	**120,000**
Education Allowance ($10k/sem/child/2 max))	Faculty	40,000	-	10,000	20,000	20,000	30,000	40,000	40,000	40,000	40,000	**240,000**
Start-Up Support	Faculty	150,000	-	150,000	-	-	150,000	-	-	-	-	**300,000**
Total Allowances			**22,500**	**220,286**	**85,571**	**85,571**	**270,857**	**125,857**	**115,571**	**115,571**	**105,286**	**1,147,071**
Other Operating Expenses	**Unit**	**Cost**										
Program contingency to recruit faculty			-	50,000	-	-	50,000	-	-	-	-	**100,000**
Fall & Spring Faculty from Duke (shared w/UG)	per person	4,000	- -	- -	1 4,000	1 4,000	1 4,000	1 4,000	2 8,000	2 8,000	2 8,000	**40,000**
Visa/Work Permit - Long Term	per person	3,000		-	3,000	-	-					**3,000**
Web Development for DKU presence and maintenance			-	10,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	**31,000**
Student Recruiting & Marketing (in China)			-	40,000	40,000	40,000	20,000	20,000	20,000	20,000	20,000	**220,000**
Student Recruiting & Marketing (outside China)			-	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	**80,000**
Recruit 2-3 PH.D. students to begin in Durham Fall 2016		-	-	-	-	-	-	-	-	-	-	**-**
Contingency to cover unanticipated expenses				10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	**80,000**
Total Other Operating Expenses			**-**	**120,000**	**70,000**	**67,000**	**97,000**	**47,000**	**51,000**	**51,000**	**51,000**	**554,000**
Program Expenses												
Server for Lab			-	20,000								**20,000**
Instructional Costs (at DKU only)	per student	1,000	-		5,000	15,000	25,000	35,000	50,000	50,000	50,000	**230,000**
Other (at DKU only)	per student	1,000	-		5,000	15,000	25,000	35,000	50,000	50,000	50,000	**230,000**
Total Program Expenses			**-**	**20,000**	**10,000**	**30,000**	**50,000**	**70,000**	**100,000**	**100,000**	**100,000**	**480,000**
Program Support Fee to Duke (100% of 2nd Year Net Tuition)* - TBD			-	-	-	100% 107,833	100% 328,977	100% 548,418	100% 761,485	100% 1,090,463	100% 1,090,463	**3,927,639**
**Contribution to Pratt Overhead*												
Subtotal for Service Fee (on Duke incurred expenses only)				-	19,125	19,125	19,125	19,125	19,125	19,125	19,125	
Service Fee W/H Taxes			-	-	1,913	1,913	1,913	1,913	1,913	1,913	1,913	**13,388**
TOTAL PROGRAM EXPENSES			**118,102**	**592,348**	**551,632**	**697,715**	**1,214,395**	**1,384,048**	**1,620,829**	**1,949,806**	**1,939,520**	**10,068,395**

Pratt School of Engineering
DKU ECE Masters Program
Duke-Based Financial Analysis - Worst Case Scenario

			FY16/17		FY17/18		FY18/19		FY19/20		FY20/21		FY21/22		FY22/23		FY23/24		FY24/25		FY25/26		FY26/27	Total
Student Enrollment			0		0		0		0		5		15		25		35		50		50		50	
REVENUE																								
Revenue (Program Support Fee from DKU)			$0		$0		$0		$0		$107,833		$328,977		$548,418		$761,485		$1,090,463		$1,090,463		$1,090,463	$5,018,101
Revenue (Study Away Fee)	0%	$22,694	$0		$0	$22,694	$0	$22,694	$0	$22,694	$113,470	$22,694	$340,410	$22,694	$567,350	$22,694	$794,290	$22,694	$1,134,700	$22,694	$1,134,700	$22,694	$1,134,700	$5,219,620
Total Revenue			**$0**		**$0**		**$0**		**$0**		**$221,303**		**$669,387**		**$1,115,768**		**$1,555,775**		**$2,225,163**		**$2,225,163**		**$2,225,163**	**$10,237,721**
30% Return to Department	30%		$0		$0		$0		$0		$66,391		$200,816		$334,731		$466,733		$667,549		$667,549		$667,549	$3,071,316
70% Maintained by School	70%		$0		$0		$0		$0		$154,912		$468,571		$781,038		$1,089,043		$1,557,614		$1,557,614		$1,557,614	$7,166,405
Total Revenue			**$0**		**$0**		**$0**		**$0**		**$221,303**		**$669,387**		**$1,115,768**		**$1,555,775**		**$2,225,163**		**$2,225,163**		**$2,225,163**	**$10,237,721**
EXPENSES																								
Pratt Faculty Expenses																								
Xin Li	50.0%	$175,000	$43,750	2.5%	$89,688	2.5%	$91,930	2.5%	$94,228	2.5%	$96,584	2.5%	$98,998	2.5%	$101,473	2.5%	$104,010	2.5%	$106,610	2.5%	$109,276	2.5%	$112,007	$1,048,553
POP #1	100.0%	$105,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$52,500	2.5%	$107,625	2.5%	$110,316	2.5%	$113,074	2.5%	$115,900	2.5%	$118,798	2.5%	$121,768	$739,980
T/TT#1	100.0%	$175,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$87,500	2.5%	$179,375	2.5%	$183,859	2.5%	$188,456	2.5%	$193,167	2.5%	$197,996	$1,030,354
POP #2	0.0%	$110,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	$0
T/TT#2	0.0%	$180,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$0	$0
Fringe Benefits		26.5%	$11,594	27.5%	$24,664	27.5%	$25,281	27.5%	$25,913	27.5%	$40,998	27.5%	$80,884	27.5%	$107,570	27.5%	$110,259	27.5%	$113,016	27.5%	$115,841	27.5%	$118,737	$774,757
Start Up 1			$0		$0		$0		$0		$0		$150,000		$150,000		$150,000		$150,000		$150,000		$0	$750,000
Start Up 2																								
Relocation			$10,000		$0		$0		$0		$10,000		$10,000		$0		$0		$0		$0		$0	$30,000
Recruitment Expenses			$0		$0		$0		$0		$5,000		$5,000		$0		$0		$0		$0		$0	$10,000
Subtotal			$65,344		$114,352		$117,210		$120,141		$205,082		$540,007		$648,734		$661,202		$673,982		$687,082		$550,509	$4,383,644
Other Faculty Expenses																								
Contract with Fuqua		$25,000	$0		$0		$0		$0		$25,000		$25,000		$25,000		$50,000		$75,000		$100,000		$100,000	$400,000
Subtotal			$0		$0		$0		$0		$25,000		$25,000		$25,000		$50,000		$75,000		$100,000		$100,000	$400,000
Staff Expenses																								
DMSA	100%	$50,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$25,000	2.5%	$25,000	2.5%	$52,531	2.5%	$53,845	2.5%	$55,191	2.5%	$56,570	2.5%	$57,985	$326,122
Lab Manager	50%	$60,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$30,000	2.5%	$30,750	2.5%	$31,519	2.5%	$32,307	2.5%	$33,114	2.5%	$33,942	2.5%	$34,791	$226,423
TA		$2,500	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%	$5,000	0.0%	$10,000	0.0%	$15,000	0.0%	$15,000	0.0%	$25,000	0.0%	$25,000	0.0%	$25,000	$120,000
Career Services Advisor	100%	$50,000	$0	2.5%	$0	2.5%	$0	2.5%	$0	2.5%	$25,000	2.5%	$25,625	2.5%	$52,531	2.5%	$53,845	2.5%	$55,191	2.5%	$56,570	2.5%	$57,985	$326,747
Fringe Benefits		26.5%	$0	27.5%	$0	27.5%	$0	27.5%	$0	27.5%	$22,000	27.5%	$22,378	27.5%	$37,560	27.5%	$38,499	27.5%	$39,461	27.5%	$40,448	27.5%	$41,459	$241,805
Subtotal			$0		$0		$0		$0		$107,000		$113,753		$189,141		$193,495		$207,957		$212,531		$217,219	$1,241,096
Language Program																								
Instruction	3%	$1,850	$0	$1,906	$0	$1,963	$0	$2,022	$0	$2,082	$10,411	$2,145	$32,170	$2,209	$55,225	$2,275	$79,634	$2,344	$117,176	$2,414	$120,692	$2,486	$124,312	$539,620
Subtotal			$0				$0		$0		$10,411		$32,170		$55,225		$79,634		$117,176		$120,692		$124,312	$539,620
Instructional Costs		$1,000	$0		$0		$0		$0		$5,000		$15,000		$25,000		$35,000		$50,000		$50,000		$50,000	$230,000
Other Costs		$1,000	$0		$0		$0		$0		$5,000		$15,000		$25,000		$35,000		$50,000		$50,000		$50,000	$230,000
Subtotal			$0		$0		$0		$0		$10,000		$30,000		$50,000		$70,000		$100,000		$100,000		$100,000	$460,000
Total Expenses			**$65,344**		**$114,352**		**$117,210**		**$120,141**		**$357,493**		**$740,930**		**$968,100**		**$1,054,331**		**$1,174,115**		**$1,220,304**		**$1,092,040**	**$7,024,360**
Surplus/(Deficit)			($65,344)		($114,352)		($117,210)		($120,141)		($136,190)		($71,543)		$147,669		$501,444		$1,051,047		$1,004,858		$1,133,122	$3,213,361

Cost of Attendance for ECE - FY18/19

16 October 2016

Constant 2016 Dollars

International Students	Year 1 (Fall 18/Spring 19) at DKU			Year 2 (Fall 19/Spring 20) at Duke			
Figures in USD	**Fall**	**Spring**	**Total**	**Fall**	**Spring**	**Total**	**Notes**
Paid to DKU							
Tuition	24,780	24,780	49,560	24,780	24,780	49,560	$22,941 of this Year 2 tuition is also included in the Study Away Fee
Housing[1]	1,230	1,230	2,460	*included in Study Away Fee*			
Total Paid to DKU	**26,010**	**26,010**	**52,020**	**24,780**	**24,780**	**49,560**	
Paid to Duke *(Study Away Fee)*				**18,988**	**17,941**	**36,929**	
Estimated Other Student Educational & Living Expenses							
Meals[2]	1,454	1,454	2,908	*included in Study Away Fee*			DKU
Books & Supplies	620	620	1,240	620	620	1,240	DKU / Grad School
International Travel[3]	2,250	-	2,250	N/A	N/A		DKU
Domestic Travel[4]	N/A	N/A		1,000	-	1,000	
Miscellaneous/Personal Expenses	1,708	1,708	3,416	1,520	1,900	3,420	DKU / Grad School
Transportation[5]	N/A	N/A		760	950	1,710	Grad School
International Health Insurance[6]	616	616	1,232	*included in Study Away Fee*			DKU
Estimated Loan Fees	N/A	N/A		462	462	924	Grad School
Total Personal Expenses	**6,648**	**4,398**	**11,046**	**4,362**	**3,932**	**8,294**	
							Total USD Total USD w/o Program Fee
Total Cost of Attendance	**32,658**	**30,408**	**63,066**	**48,130**	**46,653**	**94,783**	**$157,849 $137,849**

[1] Student residence is closed during the winter break between the fall and spring semesters and for seven days during the Chinese New Year Holiday. Students wishing to stay on campus during these periods can purchase an intersession or holiday residence package at an additional cost.

[2] Student canteen is closed during the winter break between the fall and spring semesters and for seven days during the Chinese New Year Holiday. Students wishing to stay on campus during these periods can purchase an intersession or holiday residence package at an additional cost.

[3] International Travel includes an estimate of the cost of one roundtrip to the US for Chinese students or from an international destination to Shanghai for international students, typical visa costs, and in the case of non Chinese students additional health check and registration costs associated with establishing legal residence in China for non-Chinese students. Students wishing to return to their home countries during breaks in their study before the end of the year should budget additional funds for these trips.

[4] Chinese students should plan to return home during the winter break between semesters and during the Chinese New Year holiday when the campus is closed or offers only limited services.

[5] DKU offers regularly scheduled shuttle service between campus and destinations in downtown Kunshan at no cost to students. Students wishing to travel outside regularly scheduled hours or to points outside of Kunshan should budget additional funds for these trips while in China.

[6] Health Insurance in China is required of all international students and strongly recommended for Chinese students. International students must either purchase a plan arranged by DKU or provide proof of insurance for another plan with equivalent coverage.

International Students	August 2019 - May 2020						
	With Housing/Dining			Without Housing/Dining			
Study Away Fee	Fall	Spring	**Total**	Fall	Spring	**Total**	**Notes**
Program Fee	10,000	10,000	**20,000**	10,000	10,000	**20,000**	2nd Year Net Tuition
Duke Apartment Housing (Balance)	3,848	4,810	**8,658**	N/A	N/A	**N/A**	Grad School
Duke Dining Plan[1]	2,064	2,580	**4,644**	N/A	N/A	**N/A**	Grad School
Transcript Fee	-	N/A	**0**	-	N/A	**0**	Grad School - Not charged to DKU students
Student Health Fee	386	386	**772**	386	386	**772**	Grad School
Student Health Insurance[2]	2,525	N/A	**2,525**	2,525	N/A	**2,525**	Grad School (Fall and Spring)
Graduate Student Activities Fee	18	18	**36**	18	18	**36**	Grad School
Graduate Student Services Fee	10	10	**20**	10	10	**20**	Grad School
Student Recreation Fee	137	137	**274**	137	137	**274**	Grad School (Fall and Spring)
Total	**18,988**	**17,941**	**36,929**	**13,076**	**10,551**	**23,627**	

Study Away Fee Notes

- Health Insurance is required of all students and can be waived if student has other appropriate coverage.

- All fees and rates provided at this time are ***estimates;*** *rates except for insurance will be approved in January*

[1] A meal plan is required for graduate/professional students living on Central Campus during the academic year; a summer meal plan is optional.

[2] Insurance plan year is Aug 1-July 31; rates are approved in April each year; insurance will be charged at the actual approved rate regardless of prior estimates.

PRC Students	Year 1 (Fall 18/Spring 19) at DKU			Year 2 (Fall 19/Spring 20) at Duke			
Figures in RMB	**Fall**	**Spring**	**Total**	**Fall**	**Spring**	**Total**	**Notes**
Paid to DKU							
Tuition	90,000	90,000	180,000	90,000	90,000	180,000	Using Year 1 DKU Rates with the balance in Study Away Fee
Housing[1]	8,000	8,000	16,000	*included in Study Away Fee*			
Total Paid to DKU	**98,000**	**98,000**	**196,000**	**90,000**	**90,000**	**180,000**	
Paid to Duke *(Study Away Fee)*	-	-	-	**123,422**	**116,617**	**240,039**	
Estimated Other Student Educational & Living Expenses							
Meals[2]	9,450	9,450	18,900	*included in Study Away Fee*			DKU
Books & Supplies	4,030	4,030	8,060	4,030	4,030	8,060	DKU / Grad School
International Travel[3]	N/A	N/A		15,500	-	15,500	DKU
Domestic Travel[4]	4,000	-	4,000	N/A	N/A		DKU
Miscellaneous/Personal Expenses	6,750	6,750	13,500	9,880	12,350	22,230	DKU / Grad School
Transportation[5]	N/A	N/A		4,940	6,175	11,115	Grad School
International Health Insurance[6]	4,000	4,000	8,000	*included in Study Away Fee*			DKU / Grad School
Estimated Loan Fees	N/A	N/A		N/A	N/A		
Total Personal Expenses	**28,230**	**24,230**	**52,460**	**34,350.00**	**22,555**	**56,905**	
							Total RMB Total USD
Total Cost of Attendance	**126,230**	**122,230**	**248,460**	**247,772**	**229,172**	**476,944**	**725,404 $111,601**

[1] Student residence is closed during the winter break between the fall and spring semesters and for seven days during the Chinese New Year Holiday. Students wishing to stay on campus during these periods can purchase an intersession or holiday residence package at an additional cost.

[2] Student canteen is closed during the winter break between the fall and spring semesters and for seven days during the Chinese New Year Holiday. Students wishing to stay on campus during these periods can purchase an intersession or holiday residence package at an additional cost.

[3] International Travel includes an estimate of the cost of one roundtrip to the US for Chinese students or from an international destination to Shanghai for international students, typical visa costs, and in the case of non Chinese students additional health check and registration costs associated with establishing legal residence in China for non-Chinese students. Students wishing to return to their home countries during breaks in their study before the end of the year should budget additional funds for these trips.

[4] Chinese students should plan to return home during the winter break between semesters and during the Chinese New Year holiday when the campus is closed or offers only limited services.

[5] DKU offers regularly scheduled shuttle service between campus and destinations in downtown Kunshan at no cost to students. Students wishing to travel outside regularly scheduled hours or to points outside of Kunshan should budget additional funds for these trips while in China.

[6] Health Insurance in China is required of all international students and strongly recommended for Chinese students. International students must either purchase a plan arranged by DKU or provide proof of insurance for another plan with equivalent coverage.

PRC Students	August 2019 - May 2020						
	With Housing/Dining			Without Housing/Dining			
Study Away Fee	Fall	Spring	**Total**	Fall	Spring	**Total**	
Tuition (Balance)	65,000	65,000	**130,000**	65,000	65,000	**130,000**	Grad School Tuition Total = $47,590 or 290,299 RMB
Duke Apartment Housing (Balance)	25,012	31,265	**56,277**	N/A	N/A	**N/A**	Grad School Room Total = $8,415 (fall $3,740 + Spring $4,675) or 51,332 RMB
Duke Dining Plan[1]	13,416	16,770	**30,186**	N/A	N/A	**N/A**	Grad School
Transcript Fee	-	N/A	0	0	N/A	0	Grad School - Not charged to DKU students
Student Health Fee	2,509	2,509	**5,018**	2,509	2,509	**5,018**	Grad School
Student Health Insurance[2]	16,413	N/A	**16,413**	16,413	N/A	**16,413**	Grad School (Fall and Spring)
Graduate Student Activities Fee	117	117	**234**	117	117	**234**	Grad School
Graduate Student Services Fee	65	65	**130**	65	65	**130**	Grad School
Student Recreation Fee	891	891	**1,781**	891	891	**1,781**	Grad School (Fall and Spring)
Total	**123,422**	**116,617**	**240,039**	**84,994**	**68,582**	**153,576**	

Study Away Fee Notes

- Health Insurance is required of all students and can be waived if student has other appropriate coverage.

- All fees and rates provided at this time are ***estimates;*** *rates except for insurance will be approved in January*

[1] A meal plan is required for graduate/professional students living on Central Campus during the academic year; a summer meal plan is optional.

[2] Insurance plan year is Aug 1-July 31; rates are approved in April each year; insurance will be charged at the actual approved rate regardless of prior estimates.

9.4. Learning Assessment Plan

The following learning outcomes are defined for the proposed program.

Technical Knowledge

1. Develop skills necessary to effectively contribute to the technical needs of an organization. Specifically, students should be able to:
   a) demonstrate expertise in their chosen discipline;
   b) apply knowledge to solve existing and emerging challenges.

Business Fundamentals

2. Apply their knowledge of business fundamentals to real-world situations. Specifically, students should be able to:
   a) define business terminology and practices;
   b) assess scenarios to extract relevant data, identify problems, evaluate options, analyze consequences and recommend solutions;
   c) formulate a strong case for their judgments based on data, presenting points logically and clearly.

Leadership

3. Demonstrate an understanding of being a leader and developing their own leadership style. Specifically, students should be able to:
   a) learn and be able to apply leadership principles in a group setting;
   b) develop emotional intelligence to work with diverse leadership styles;
   c) define ethics and be able to hold them up in practice.

Teamwork

4. Demonstrate an understanding of team dynamics and work effectively in diverse groups. Specifically, students should be able to:
   a) describe the characteristics of high performing teams as well as the difficulties often encountered;
   b) employ effective strategies for team formation, operation, and communication to analyze complex situations and develop appropriate actions;
   c) collaborate with peers to successfully create and complete a team-based assignment or project;
   d) evaluate peer performance, clearly outlining strengths as well as areas for improvement.

Communication

5. Demonstrate a command of core written and verbal communication skills appropriate for their targeted fields. Specifically, students should be able to:
   a) create a comprehensive individual project report that is mechanically correct, well-

organized, and indicative of logical development and analysis;

b) speak publicly, selecting appropriate content and materials, clearly organizing information, delivering an effective presentation, and adapting to the audience as needed.

Cultural Awareness

6. Students should be able to understand and demonstrate an ability to work within a global context. Specifically, students should be able to:
   a) define cultural diversity and explain the implications for business;
   b) analyze the commonalities and differences between various global cultures, selecting appropriate actions based on cultural context.

Summer Internship and Industrial Preparation Courses

In addition to the assessment criteria defined by individual technical courses based on in-classroom discussions, homework assignments, course projects, exams, etc., the learning outcomes of our proposed ECE MEng program will be carefully evaluated according to the student performance for their summer internship and two industry preparation courses:

- Summer Internship Assessment
- Management of High Tech Industries (MENG 540)
- Business Fundamentals for Engineers (MENG 570)

Table 16. Learning outcomes and assessment for the ECE MEng program at DKU

Outcome	Proposed Measure
Technical Knowledge: Develop skills necessary to effectively contribute to the technical needs of an organization.	- Rubric evaluated for Summer Internship Report - Outcome of Technical Knowledge Questions for Graduate Exit Survey (see below)
Business Fundamentals: Apply their knowledge of business fundamentals to real-world situations.	- Rubric evaluated for Business Model Presentation, Business Simulation Presentation and Executive Summary from MENG 570 - Outcome of Business Fundamentals Questions for Graduate Exit Survey (see below)
Leadership: Demonstrate an understanding of being a leader and develop your own leadership style when working with others.	- Rubric evaluated for Final Exam and Final Team Project from MENG 540 - Outcome of Leadership Questions for Graduate Exit Survey (see below)
Teamwork: Demonstrate an understanding of team dynamics and work effectively in diverse groups.	- Rubric evaluated for Final Team Project from MENG 540 - Rubric evaluated for Business Plan Presentation, Weekly Team Presentations, Business Simulation Presentation and Business Model Presentation from

	MENG 570 - Outcome of Teamwork Questions for Graduate Exit Survey (see below)
Communication: Demonstrate a command of core written and verbal communication skills appropriate for their targeted fields.	- Rubric evaluated for Summer Internship Report - Rubric evaluated for Final Team Project from MENG 540 - Rubric evaluated for Business Plan Presentation, Weekly Team Presentations, Business Simulation Presentation, Business Model Presentation and Executive Summary from MENG 570 - Outcome of Communication Questions for Graduate Exit Survey (see below)
Cultural Awareness: Students should be able to understand and demonstrate an ability to work within a global context.	- Rubric evaluated for Final Exam from MENG 540 - Rubric evaluated for Form Your Team from MENG 570 - Outcome of Cultural Awareness Questions for Graduate Exit Survey (see below)

Learning Objective Questions of Graduate Exit Survey

- Technical Knowledge
  - I have developed skills necessary to effectively contribute to the technical needs of an organization.
  - I have the ability to demonstrate expertise in my chosen discipline.
- Business Fundamentals
  - I have the ability to integrate engineering and business to make organizational decisions.
  - I have a strong knowledge of business fundamental (terminology and practices).
- Leadership
  - I have demonstrated an understanding of being a leader and developed my own leadership style.
- Teamwork
  - I have the ability to work productively as a team, taking advantage of individual diversity.
- Communication
  - I have the ability to create a comprehensive individual project report that is mechanically correct, well-organized, and indicative of logical development and analysis.
  - I have the ability to speak publicly, selecting appropriate content and materials, clearly organizing information, delivering an effective presentation, and adapting to the audience as needed.
- Cultural Awareness

- I have a comprehension of and ability to work within a global context.

GSC Assessment Report

In the spirit of consistency with other programs currently offered at DKU, the Graduate Study Committee (GSC) of our proposed ECE MEng program will explicitly review, discuss, and report student outcomes based upon the following items:

- What outcomes were you scheduled to assess during this annual reporting period? What outcomes did you assess?
- What evidence did you collect? Summarize your findings.
- What did you and your faculty learn about your program and/or your students from the evaluation of the evidence? What strengths and areas of concern have emerged?
- As a result of your assessment, what changes, if any, have you and your faculty implemented or plan to implement to address areas of concern?
- What outcomes are you planning to assess for the next annual reporting period?

We will work with Office of the Vice Provost for Academic Affairs and the Office of DKU Programs on further developing our evaluation rubric with an estimated completion date of Summer 2018 for submission to SACS prior to Fall 2018, pending approvals by Duke faculty and the Duke and DKU Boards.

9.5. Support letters

The following reference letters are collected:

- Pankaj Agarwal (Chair), CS, Duke
- Ravi Bellamkonda (Dean), Pratt, Duke
- Krishnendu Chakrabarty (Chair), ECE, Duke
- James Dobbins (Associate Vice Provost and Director), Office of DKU Programs, Duke
- Brad Fox (Associate Dean for Professional Master Programs), Pratt, Duke
- Aaron Franklin (DGS), ECE, Duke
- Haiyan Gao (Vice Chancellor for Academic Affairs), DKU
- Deborah Jakubs (VP of Library Affairs), Duke
- Jonathan Mattingly (Chair), Mathematics, Duke

Duke University
DURHAM
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27708-0129

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February 6, 2018

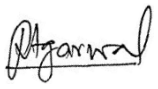
Dear Colleagues:

On behalf of the Computer Science Department, I express my support for the international Master of Engineering (MEng) program in Electrical and Computer Engineering (ECE) at Duke Kunshan University (DKU).

My understanding is that the proposed ECE MEng program is expected to recruit 100 students per year at the steady state. These students will spend their second year at Duke. Based on the current statistics, about 50% of the ECE master students will pursue the computer engineering area and the other 50% students will take the big data area. Among the 50 students in computer engineering, a subset of them might be interested in taking two CS courses: Introduction to Algorithms (CS 531), and Computer Networks and Distributed Systems (CS 514). Assuming there is available space in the aforementioned classes, CS will closely work with ECE to accommodate these students in these classes.

We are excited and look forward to this opportunity for international education to the global society.

Sincerely,



Pankaj K. Agarwal
Chair and RJR Nabisco Professor of Computer Science
Professor of Mathematics

RAVI V. BELLAMKONDA
Vinik Dean of Engineering
305 Teer Engineering Building
Box 90271
Durham, NC 27708-0271
(919) 660 5389 [phone]
(919) 684 4860 [fax]

March 15, 2017

Dear Colleagues:

It is my pleasure to write this letter in support of the international Master of Engineering (MEng) program in Electrical and Computer Engineering (ECE) at Duke Kunshan University (DKU).
The Pratt School of Engineering is a vibrant teaching and research institution dedicated to training the next generation of leaders and exploring the frontiers of engineering to develop solutions to the world's greatest challenges. We combine technical expertise with broad perspectives and offer a highly interdisciplinary environment. Our mission is to provide a rigorous engineering education for both undergraduate and graduate students, enabling them to lead productive, rewarding, and ethical lives for the betterment of society. It is our vision that Duke engineering students and faculty will be catalysts for generating and integrating knowledge across the disciplines required to address complex issues facing a global society.

We are extremely excited to know about the new development on applied physical sciences and engineering at DKU. It offers numerous opportunities for international education, interdisciplinary research, culture development, technology transfer, etc. Collaborating with DKU on these activities would enormously grow our global reputation and international leadership in China and its neighboring countries, eventually bringing a variety of resources (e.g., high-quality students, international collaborators, etc.) to enhance our own education and research at Pratt.

Establishing the proposed ECE MEng program is the first step to initiate our collaboration with DKU. To support this program, Pratt will coordinate with other administrative and academic units at both Duke and DKU to offer the required resources, including faculty/staff recruitment, classroom space, etc. We are fully committed to co-develop a world-class, global and interdisciplinary ECE MEng program with DKU.

Finally, I would like to re-emphasize our strong interests to work with DKU to establish the ECE MEng program, as well as other new education and research initiatives in the future. By collaborating with DKU, we are looking forward to a great success in the near future.

Sincerely,

Ravi V. Bellamkonda, PhD
Vinik Dean of Engineering

Duke UNIVERSITY | ELECTRICAL & COMPUTER ENGINEERING

Box 90291
Durham, NC 27708
Phone: 919-660-5252
Fax: 919-660-5293

10/03/2017

Dear Colleagues:

On behalf of ECE, I am writing this letter to express my strong support for the international Master of Engineering (MEng) program in electrical and computer engineering (ECE) at Duke Kunshan University (DKU).

The ECE department at Duke is the home of world-class education and research, characterized by a firm engineering foundation, grounded by the classes and experience of Duke's unique environment on liberal arts. The Duke ECE department currently has about 237 undergraduate students, 170 master's students and 161 PhD students. These ECE students acquire not only engineering breadth and depth, but also superior communication skills, with an appreciation for how engineering fits within broader society. After graduation, they often achieve leadership roles in a wide array of fields. In addition to working for academic universities, research labs and industrial companies in the engineering field, many Duke ECE graduates pursue their careers in other fields such as business, law, and medicine.

We are highly interested in collaborating with DKU to build the proposed MEng program by leveraging our current strength of interdisciplinary education and research. We anticipate that the engagement with DKU will add the global component to our current infrastructure of student recruitment and training, resource sharing, technology transfer, etc., and, eventually, establish our international leadership in the global community.

Once the proposed program is approved, ECE will actively communicate with Pratt and DKU to secure the required resources to support the program. We will also closely work with DKU on a variety of activates to develop, monitor and refine the program, including faculty search, student admission, curriculum development, etc.

In summary, the ECE department is keen to collaborate with DKU and support the proposed MEng program. It offers enormous opportunities for us to grow our education and research activities, establish our international leadership, and bring our service to the global society.

Sincerely,

Krishnendu Chakrabarty, PhD
Professor and Chair of Electrical and Computer Engineering

Duke UNIVERSITY | Office of DKU Programs

James T. Dobbins III, PhD
Associate Vice Provost and Director
101 Allen Building | 421 Chapel Drive
Box 90036 | Durham, NC 27708
Telephone: (919) 668-0377
james.dobbins@duke.edu

December 6, 2016

Xin Li, Ph.D.
Department of Electrical and Computer Engineering
Pratt School of Engineering
Duke University
Box 90291
Durham, NC 27708

Dear Xin,

I am writing to express my enthusiastic support for the International Master of Engineering in Electrical and Computer Engineering (ECE MEng) program that you are proposing for Duke Kunshan University. The ECE program will add an important new dimension to Duke Kunshan University by expanding graduate education in the engineering field, and contributing to the development of research initiatives within the Applied Physical Sciences and Engineering (APSE) center. From a Duke perspective, the program will bridge educational and research activities of both institutions, engaging faculty and students in global, integrated initiatives in engineering and applied physical sciences. I am confident the program will have a significant impact on Duke and DKU.

My office will work closely with the team at DKU to ensure that this new program maintains the quality standards that we would expect from a Duke program. That engagement will involve active participation by faculty at Pratt in charting this program's future success.

I believe strongly that this program will add great value to Duke and to DKU and you have my full and enthusiastic support.

Sincerely,

James T. Dobbins III, Ph.D., FAAPM
Associate Vice Provost
Professor of Radiology, Biomedical Engineering, and Physics
Director Emeritus, Medical Physics Graduate Program
Chair, Education Council, American Association of Physicists in Medicine
Co-founder, Society of Directors of Academic Medical Physics Programs, Inc

Duke
PRATT SCHOOL OF
Engineering

BRADLEY A. FOX, PH. D.
ASSOCIATE DEAN, MASTERS PROGRAMS

March 13, 2017

Dear Review Committee:

The Masters of Engineering in Electrical and Computer Engineering (ECE) has requested a letter of support for the proposed masters degree program at DKU. The Master of Engineering degrees are administered and supported by the Masters Programs unit within the Pratt School of Engineering. This unit is responsible for the two industry preparation courses (MEng 540 Management of High Tech Industries and MEng 570 Business Fundamentals for Engineers) along with various academic and student services including admissions, language training, career services, MEng community and student engagement, accreditation, orientation, and graduation. The ECE department is responsible for the technical courses in the program, advising, applicant selection, graduation verification, and for developing community within the ECE masters students. The department's ability to support these responsibilities will be covered in the letter from the Electrical and Computer Engineering Department. This letter will address the ability of the Masters Programs unit to support these students.

The current incoming class of all MEng students across 7 majors is typically 40-50 students. Adding 100 students in a single major to this cohort will require additional resources as outlined in the proposal. It will also significantly change the demographics of the student body. The key resources needed to accommodate these students are

- 1.5 Instructors for MEng 540 and MEng 570
- 2 Language instructors
- 1 Career Counselor
- 1 Program coordinator
- Classroom space
- Office space for the additional faculty and staff and student spaces for the additional students
- Operating funds, including travel funds for staff and faculty to ensure a cohesive experience between Kunshan and Durham.

The proposal includes the personnel resources detailed above. The space for this program does not currently exist, but is contingent on a new engineering building being built and renovating vacated space for the masters programs. If this new building is not built and new space is not

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Pratt School of Engineering, 3405A Fitzpatrick Center, Duke University, Box 90271, Durham, North Carolina 27708-0271
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allocated for masters programs, then it will not be possible to accommodate additional students.

There are resources that will be required to support this program that are not included in the proposal. These resources relate to start-up, coordination, and ongoing operations. We believe this can be managed by our existing staff; however, this is a significant assumption and depends on other efforts and initiatives within the Pratt School of Engineering that may also compete for staff time. For example, there are no Durham staff associated with admissions and application processing or with visa processing. We have spoken with the SISS office and it is expected to take about 3 months to develop, test, and troubleshoot a separate admissions pathway for ECE students at DKU. In addition to the start-up effort, admissions processing requires ongoing effort throughout the recruitment cycle. This workload will likely fall on our Assistant Director of Admissions. We believe these activities may be incorporated into the existing workload. If this workload exceeds current expectations, additional resources will be needed.

The Masters of Engineering in Electrical and Computer Engineering (ECE) DKU is a valuable program that will strengthen Duke's global presence. This letter outlines the resources needed to support this program and some of the resource risks within this proposal.

With these resources in place, we look forward to developing this new program and providing the students with a great learning experience.

Sincerely,

Bradley A. Fox

Duke | DEPARTMENT OF Electrical & Computer Engineering

Dr. Aaron D. Franklin
Associate Professor
Executive Director of Graduate Studies
130 Hudson Hall, Box 90291
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(919) 681-9471 [phone]
aaron.franklin@duke.edu

9 October 2017

Dear Colleagues,

As the Executive Direction of Graduate Studies (DGS) of Electrical and Computer Engineering (ECE) at Duke, I am delighted to write this letter to support the proposal for an international Master of Engineering (MEng) Program in ECE at Duke Kunshan University (DKU).

Our existing master's program at Duke ECE hosts around 170 students with about 70% of these students from China. The proposed ECE MEng program at DKU would enormously strengthen our master's education through three complementary avenues:

First, DKU is able to offer a variety of local recruitment events in China, including information sessions, summer camps, open houses, etc. These channels effectively advertise and promote our ECE master's program and internationally grow our reputation in China and its neighboring countries. Due to these recruitment activities, our application pool is expected to be substantially enlarged, facilitating recruitment of higher quality master's students. It would also offer a valuable channel to identify and recruit high-quality PhD students to study at Duke ECE.

Second, the proposed MEng program offers a customized education plan for non-US students. Most non-US students (particularly, Chinese students) are trained by a different education system with different language, curriculum, culture, etc. The proposed program allows these students to stay in China for the first year where they receive US-style education in their home country. In addition, DKU offers two English and professional training courses during the first year that cover language, presentation, writing, communication, academic integrity, and social skills. Such an intercultural education plan plays a critical role in helping foreign students make a smooth transition to the US.

Third, the proposed MEng program is carefully designed with global components and well positioned to meet the rapid and remarkable technological advancements in today's global environment, including US, China and other neighboring countries. The education and training offered by this program is able to provide our students with the necessary background knowledge and technical skills to grow their long-term career along an international roadmap and, eventually, become global leaders.

For these reasons, I am strongly supporting the proposed ECE MEng program at DKU. Once the program is fully approved, the ECE graduate office will closely collaborate with DKU and other relevant offices at Duke to work on student admissions, course offerings, etc. We are extremely excited about this opportunity and are looking forward to building a world-class MEng program together with DKU!

Sincerely,

Aaron Franklin

November 8, 2016

Dear colleagues:

On behalf of the senior leadership team at DKU, I am writing to most enthusiasitically endorse the proposal for an International Master of Engineering (MEng) Program in Electrical and Computer Engineering (ECE) at Duke Kunshan University.

Currently, Duke Kunshan University has four masters programs, and they are Masters of Science in Global Health, Masters of Science in Medical Physics, Masters of Management Study, and Masters of Environmental Policy. In the phase 1 plan of DKU (2013-2019), few more masters programs are in the plan for development and launch. The development of MEng in ECE fits well with the strategic plan of DKU in integrating research and education, and also adds great diversity to the existing graduate programs at DKU. Based on the on-the-ground experience at Duke Kunshan, the MEng program is expected to be in great demand in China. A few years ago, a research subcommittee of the Duke China faculty council proposed a number of research initiatives for DKU. Among which environment and applied physical sciences and engineering (APSE) are two major areas put forward. After extensive effort by colleagues at Duke and also at DKU, DKU launched the new environment research center in July 2017, and a new masters program in environmental policy with its first class coming in Fall 2017. In August 2016, the DKU board of trustees approved a plan to develop a full proposal for a program in applied physical sciences and engineering that has a research center, and graduate degree programs. The MEng is the first graduate program that the APSE program envisions. In addition to the interests and engagement of colleagues from Pratt School of Engineering, colleagues in Chemistry, Math and Physics in A&S are also heavily engaged and interested in this program of APSE.

The proposal of this MEng program is timely for its launch in fall 2018. Once the program is approved from the Duke side, DKU will be responsible for getting the program approved by the Chinese Ministry of Education, and also for providing resources for the program in terms of faculty, staff and space in order to make it a great success. Once again, we at Duke Kunshan Universty most enthusiastically endorse this proposal.

Dr. Haiyan GAO

昆山杜克大学
DUKE KUNSHAN UNIVERSITY

Vice Chancellor for Academic Affairs
Duke Kunshan University

Henry Newson Professor of Physics
Duke University

DUKE UNIVERSITY
LIBRARIES

Deborah Jakubs
Rita DiGiallonardo Holloway University Librarian
Vice Provost for Library Affairs

March 9, 2017

Professor Xin Li
Department of Electrical and Computer Engineering
Pratt School of Engineering
2529 CIEMAS Building, Box 90291
Durham, NC 27708

Dear Professor Li:

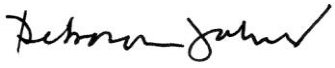
On behalf of the Duke University Libraries (DUL), I am pleased to assure you that the proposed Master of Engineering (MEng) program in Electrical and Computer Engineering (ECE) at Duke Kunshan University (DKU) will be well supported by DUL's collections. DUL's electronic resources in this field will be available to students in the program both while at DKU and when in residence at Duke. Additional print resources will be available to them while at Duke.

DUL supports ECE education with significant book collections, many of which are available electronically. The library has over 60,000 engineering books (approximately 18,000 of which are eBooks) and almost 30,000 computer science related books (approximately 16,000 of which are eBooks). For example, DUL holds the complete Synthesis Digital Library of Engineering and Computer Science collection, the SPIE eBook collection for 2008-present, all of the IEEE Wiley and MIT eBooks, and the Science Direct Computer Science collection. We also provide electronically many important reference works, such as the Electrical Engineering Handbook and all of the ASM Handbooks.

DUL subscribes to a wealth of databases with special relevance to ECE, including IEEE Xplore, SPIE Digital Library, Engineering Village and ACM Digital Library. We offer access to major scientific literature databases, including Web of Science and Scopus. DUL aims also to have comprehensive electronic access to journal and conference literature for ECE. Using Journal Citation Reports (JCR) to quantify journal coverage, DUL subscribes to 98 of the 100 electrical engineering journals with the highest impact factors as reported by JCR. JCR does not have a subject heading for computer engineering, but an analysis of computer science journals shows that Duke has 97 of the top 100 ranked journals in that field.

It is more difficult to determine whether DUL can offer the level of library services that may be needed to support the proposed program. Library instruction and research assistance for students in Pratt are provided by Melanie Sturgeon (MSE, MSLS), Librarian for Engineering, Physics and Computer Science. DUL has only four librarians, including Ms. Sturgeon, supporting all of the natural sciences, Pratt, and Nicholas, and students in Duke's current MEng program require more intensive support from Ms. Sturgeon than do undergraduate and doctoral students in Pratt. It seems likely, therefore, that service levels will be strained when the program reaches its full enrollment, if not before. It may also be difficult for DUL's Data and Visualization Services Department to absorb any demands on its services from the new program. However, DUL will endeavor to provide library services for the program as fully as resources permit.

Sincerely yours,



Deborah Jakubs

Box 90193 Duke University Durham, NC 27708-0193 Tel: 919-660-5800 Fax: 919-660-5923 library.duke.edu

Duke UNIVERSITY | DEPARTMENT OF MATHEMATICS
TRINITY COLLEGE *of* ARTS & SCIENCES

February 9, 2018

Dear Colleagues

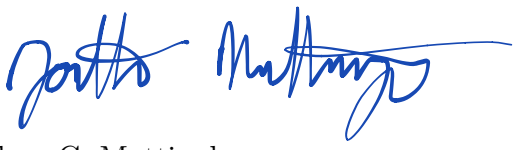
As the Chair of Department of Mathematics, I want to write this letter to strongly support the international Master of Engineering (MEng) program in Electrical and Computer Engineering (ECE) at Duke Kunshan University (DKU).

A number of students from the existing ECE master program at Duke currently take courses offered by the Mathematics Department. Hence, students from the proposed ECE MEng program are expected to follow the same routine. The Mathematics Department is extremely interested in partnering with the ECE Department to appropriately accommodate these students. Meanwhile, we will collaborate with ECE and Pratt School of Engineering to work out a financial model for sharing tuition revenue based on the student enrollment.

We equally think that this could provide an meaningful way for mathematics faculty to contribute to Duke's Masters Programs.

In summary, we will fully support the proposed ECE MEng program and are looking forward to contributing to it.

Sincerely,



Jonathan C. Mattingly
Professor of Mathematics and Statistical Science
Chair of Mathematics Department
Duke University, Durham NC

Duke Box 90320 • 120 Science Drive, 117 Physics Building • Durham, NC 27708
Tel: 919 660 2800 • Fax: 919 660 2821 • math.duke.edu

9.6. Market Survey

The detailed report was prepared by Nielsen Greater China and is attached in this sub-section.

nielsen

REPORT FOR DUKE KUNSHAN UNIVERSITY MASTER'S PROGRAMS

ELECTRICAL AND COMPUTER ENGINEERING (ECE) AND INTERDISCIPLINARY DATA SCIENCE (IDS)

Nielsen Greater China
April 2017

昆山杜克大学
DUKE KUNSHAN UNIVERSITY

AGENDA

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Estimated applicant numbers

- Approx. **6,000 students in Beijing** and **5,000 in Shanghai per year** are interested in accepting an offer for the DKU ECE & IDS programs
- This number is estimated based on # of Chinese students of relevant majors, the consideration of studying abroad and the stated interest of applying and accepting an offer based on the current program information available

One third of respondents willing to apply

- **31% of students** show strong interest in applying for either ECE or IDS program and **37% of the parents**
- Interest in applying is higher for:
  - Parents & female students
  - Tier 2 cities
  - South region
  - Engineering students

Two main impact factors on perception of DKU programs

- Plans to come back to China vs. staying in the US
- Seeing studying abroad as a way to reach their goals vs. a part of their life journey

3 groups of students can be determined

Group 1: Journey Focused Students with Plans to Come Back to China — **37%**

Group 2: Goal Focused Students with Plans to Come Back to China — **20%**

Group 3: Goal Focused Students with Plans to Stay in the US — **40%**

EXECUTIVE SUMMARY – CONT'D

Group 1 is most likely to apply and accept

Motivation to go abroad:
- Experience foreign culture and becoming independent
- General advantage in Chinese job market

Educational goals and decision factors:
- Have less specific goals for education and career path
- Focused on first step: university education
- Decide mainly by teaching quality and university reputation

Perceived benefits of DKU:
- Being able to receive a degree from a top ranking and well known university
- Career resources in China
- Transition period

Perceived barriers of DKU:
- Equality of teaching quality in DKU
- Reputation of DKU in China

Group 2 has potential to apply

Motivation to go abroad:
- Seeking a specific skill set that will bring advantages:
  - A more practically oriented education
  - Language skills
  - Cultural understanding

Educational goals and decision factors:
- More specific goals for education and career path
- Consider smaller set of majors to complement undergrad
- Plan ahead: Consider career resourced of university

Perceived benefits of DKU:
- Strongly driven by career resources, incl. internships and jobs in China
- Networking opportunities with Chinese and Americans

Perceived barriers of DKU:
- Doubts about equal quality of faculty and curriculum
- Awareness and social recognition of DKU

EXECUTIVE SUMMARY – CONT'D

Group 3 is least likely to apply and accept

Motivation to go abroad:

- See US as the best environment to be educated in a specific field, e.g. Computer Science or Electrical Engin.

Educational goals and decision factors:

- Most specific goals for education and career path, e.g. becoming a top talent in their specific field
- Most focused on rankings to ensure teaching quality

Perceived benefits of DKU:

- Appreciate career resources and transition period
- But barriers outweigh the benefits in this group

Perceived barriers of DKU:

- Strongest concerns about equality of teaching quality in DKU, incl. doubts about high admission standards and quality of faculty
- Less international settings means lower competitiveness

Potential student number closely linked to success of marketing communication

- **Understand & target different student groups**
- **Communicate the right messages**
- **Increase likeliness to apply and accept**

The more messages can be **successfully and credibly delivered**, the higher the number of applicants and acceptors of an offer for DKU ECE or IDS program

EXECUTIVE SUMMARY – CONT'D

Benefits to be communicated

- Create awareness of the programs at an early stage in their planning process
- Leverage channels: websites & forums, agencies, introductions at their universities
- Emphasize full Duke degree and ranking

- Clarify what career resources DKU can offer
- Endorse with company cooperation and alumni from China

- Provide more information about how the transition will be achieved

- Explain DKU's ability to screen applicants more carefully due to proximity to Chinese students

- Advertise scholarship opportunities

Barriers to be overcome

- Ensure equality of DKU teaching quality: Introduce faculty, explain their qualification & background, detailed curriculum and facilities
- Communicate university and major ranking, especially for DKU

- Reassure social and corporate recognition and reputation of DKU in China
- Clarify relationship and purpose of DKU campus to Duke; an additional campus to enable more Chinese talents to attend Duke

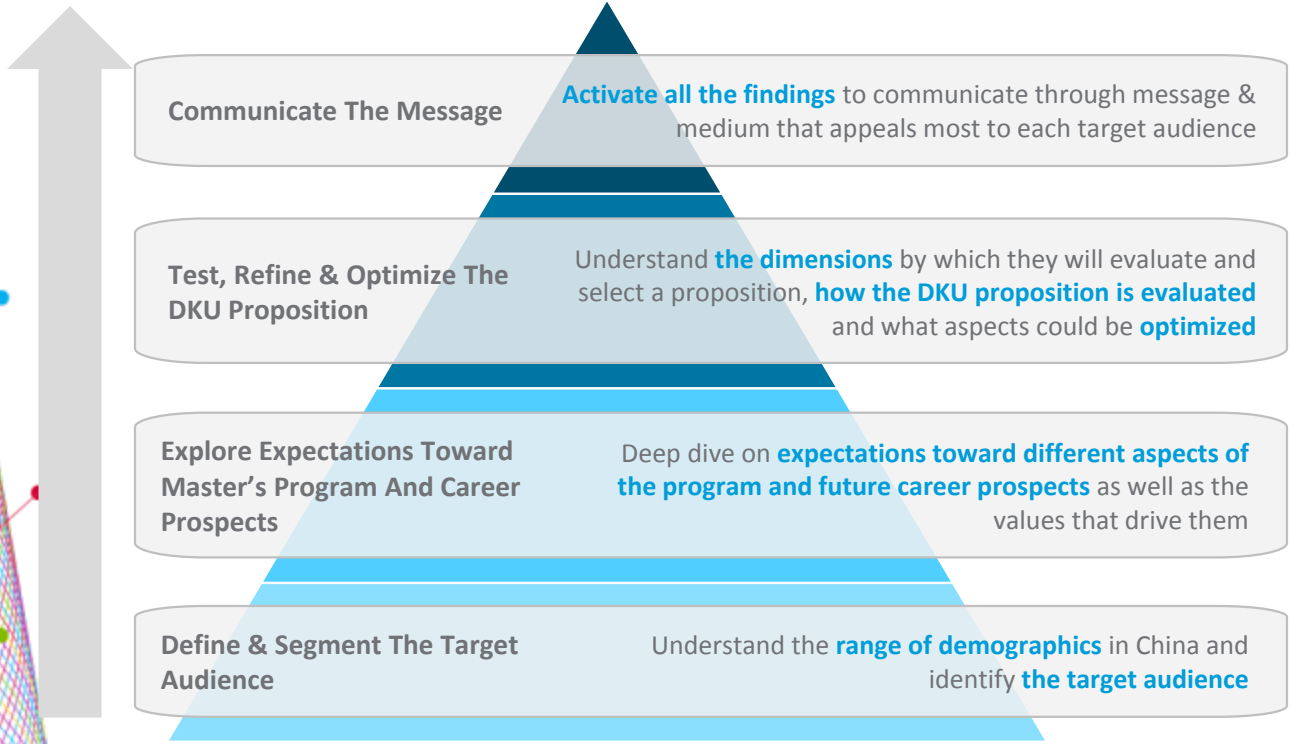
- Address concerns regarding lower admission standards and reservations toward JV schools, e.g. with application system purely through Duke

- Emphasize international campus setting to ensure competitiveness, networking opportunities and international experience

STUDY BACKGROUND

PROJECT OVERVIEW

Refining the proposition and communication of the ECE and IDS Master's Programs



The right **PROPOSITION**

The right **MESSAGING**

The right **MEDIUM**

For the right **AUDIENCE**

OVERALL RESEARCH PROCESS

The research is meant to get qualitative depth attributes and quantified validation of those findings

01

QUALITATIVE RESEARCH EXECUTION

- Uncover qualitative attributes
- Understand expectations and test proposition through in-depth interviews

02

QUANTITATIVE RESEARCH EXECUTION

- Validate qualitative findings
- Quantify segments, needs and expectations through online survey

03

REPORTING

- Aggregate findings in a complete report

QUALITATIVE SAMPLE CRITERIA

We suggest the following basic criteria. Additional TBD together with DKU and Nielsen

STUDENT GROUPS: 2ND & 3RD YEAR UNDERGRAD

- Planning to attend a master's program after undergrad
- Non-rejecters of overseas master's programs

STUDENT INTERVIEWS: 4TH YEAR UNDERGRAD

- Already applied for master's program overseas or joint program in China, or planning to attend a master's program overseas

STUDENT INTERVIEWS: CURRENT JV STUDENTS

- Current student in a joint program in China

PARENT INTERVIEWS: OVERSEAS INTENDER

- Child is a current undergrad student in China and considering to attend a master's program overseas in the below mentioned areas
- Parent has shared responsibility in the consideration process and is able to articulate their aims for their child
- Good mix of socioeconomic and educational backgrounds

COMMON CRITERIA:

- Major in Engineering (Electrical, Computer, Systems, Mechanical, Material, Civil, etc.), Data Science, Applied Math, or Statistics
- Top Tier universities preferred, but the priority is to find students in relevant majors

QUALITATIVE GEOGRAPHIC COVERAGE

Suggested geographic coverage is as follows

Students

Beijing
Shanghai

2ND YEAR UNDERGRAD	3RD YEAR UNDERGRAD	4TH YEAR UNDERGRAD	CURRENT JV STUDENTS
x 3 per city 6 in total	x 3 per city = 6 in total	x 3 per city = 6 in total	Shanghai only: 2 in total

Students

Hangzhou
Guangzhou

GOOD MIX OF 2ND/3RD/4TH YEAR UNDERGRAD

x 4 per city
8 in total

Parents

Beijing
Shanghai
Hangzhou
Shenzhen

x 3 per city =
12 in total

40 Qualitative Depth Interviews Nationwide

QUANTITATIVE DESIGN

Suggested geographic coverage is as follows (to be further discussed between DKU and Nielsen)

Methodology:

Online Interview

- ✓ Can achieve more cities with greater representativeness
- ✓ Fast turnaround, easier to monitor fieldwork status and data quality
- ✓ Cost-saving

Geographic Coverage:

NATIONWIDE

Suggest to cover different regions and mainly tier 1&2 cities (more developed) to get a more representative result, and also prioritize the key potential cities going for foreign education

City Tier	Students	Parents
National	Around 250	Around 150
Total	**400**	

Sample Design:

Students & Parents: 400 samples

Include both undergraduates and graduates with max. 3 years work experience

Students criteria:

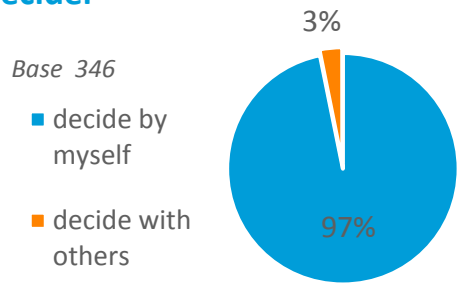
- Intend to apply for master program in the next 6-24 months, NOT reject to choose ECE and IDS as major
- Major in engineering related (material, electrical, computer…), applied math, data science, statistics,…
- Main decision makers of future postgraduate education
- Study in universities or graduated from universities (not limited to top universities)

Parents criteria:

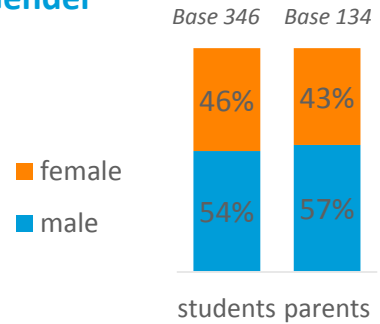
- Children intend to apply for master's program in the next 6-24 months, NOT reject to choose ECE and IDS as major
- Their children major in engineering related(material, electrical, computer…), applied math, data science, statistics…
- Study in universities or graduated from universities (not limited to top universities)

QUANTITATIVE DESIGN – RESPONDENT OVERVIEW

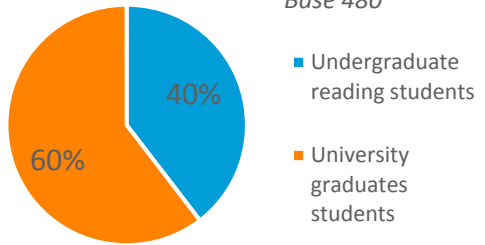
Decider



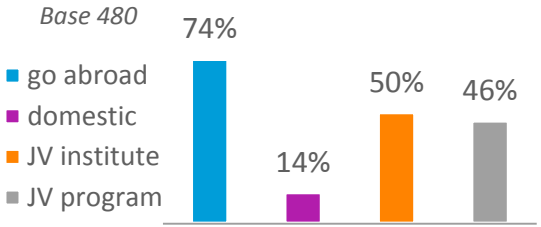
Gender



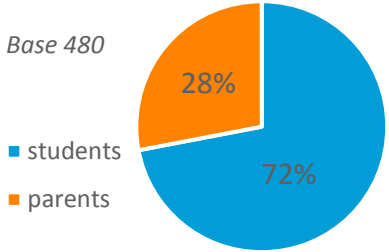
Grade



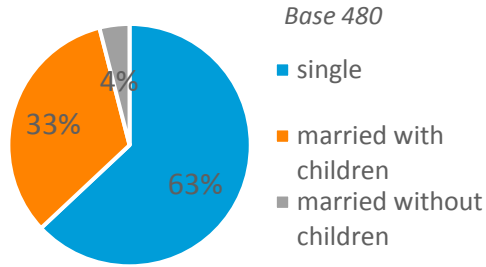
Considerations on studying abroad



Role



Marriage



IDENTIFY THE TARGET AUDIENCE

ESTIMATION OF POTENTIAL STUDENT NUMBER

- It is estimated that 6,000 students in Beijing and 5,000 in Shanghai are interested in accepting an offer for ECE/IDS programs. Please kindly notice that the data could be larger than reality depending on the information that is currently available about the program

- The estimated data in the right table are calculated from the Main Formula= Coefficient * Proportion * Base
- Coefficient=% of respondents considering studying abroad=66.6%

- Proportion = $\frac{\text{The students definitely apply for/ accept the offer of DKU } \textbf{ECE/IDS}}{1219}$ =

	ECE	IDS
Apply	6.56%	7.55%
Accept	4.02%	5.17%

N=1219 respondents studying Science/Engineer as undergraduate major participated in the survey and intend to study abroad

- Base = Science & Engineering Students in China/ Beijing/ Shanghai

Base (000)	Total	Science students	Engineering students
China	Base C= 6193.0	1073.0	5120.0
Beijing	Base B=209.0	33.7	175.3
Shanghai	Base S= 147.6	21.7	125.8

(000)	Apply		Accept	
	ECE	IDS	ECE	IDS
China	270.5	311.1	165.7	213.1
Beijing	9.1	10.5	5.6	7.2
Shanghai	6.5	7.4	3.9	5.1

Ref: Education Statistical Year Book; http://www.shmec.gov.cn/html/xxgk/201605/303142016005.php; http://www.shmec.gov.cn/html/xxgk/201605/303142016005.php

STUDENT NUMBER BY RELEVANT MAJORS

- The most interested students are undergraduates who major in mathematics, physics, electronic information and engineering-related subjects. The estimated number of top 5 majors is 454,500 in total nationwide.

Top 4 Subject Classifications with high interests (000)			
	China	Beijing	Shanghai
Mathematics	345.5	11.7	8.2
Physics	137.2	4.6	3.3
Electronic Information	127.0	4.3	3.0
Engineering	101.6	3.4	2.4

- Figures with * are sourced from public online information, and the others are estimated based on the proportion of respondents by major.

Top 5 Majors with high interests (000)			
	China	Beijing	Shanghai
Information and Computing Science	157.5	5.3	3.8
Mathematics and Applied Mathematics	37.8*	4.5	3.1
Physics	121.9	4.1	2.9
Electronic Information Engineer	71.1	2.4	1.7
Machine Design Manufacture and Automation	66.2*	2.1	1.5

Ref: Education Statistical Year Book; http://www.shmec.gov.cn/html/xxgk/201605/303142016005.php; http://www.shmec.gov.cn/html/xxgk/201605/303142016005.php

PARENTS & FEMALE STUDENTS MORE INTERESTED

- Parents are a little more interested in DKU programs than students themselves, especially for fathers. However, the programs are more attractive to female students' attention
- Although a large percentage of targeted customers will come from big cities, those who study in Tier 2 cities are more likely to apply for the programs, such as Tianjin and Nanjing

(%)

Role		**Students**				**Parents**
Total		72				28
Interested* (Base=158)		68				32
Gender		**Male**				**Female**
Student (Base=346)	Total	54				46
	Interested (base=108)	51				49
Parents (Base=134)	Total	57				43
	Interested (base=50)	74				26
Region	**East**	**South**	**West**		**North**	
Total	31	16	7		46	
Interested (Base=158)	26	20	7		47	
City Tier	**Tier1**		**Tier2**		**Tier3&4**	
Total	57		36		7	
Interested (Base=158)	46		50		4	

All respondents base=480
Ref: Q3, Q17ab, Q19, Q20

Red figures: the percentages larger than average
*Interested: Respondents selecting 'definitely apply for' ECE or IDS program in Q59

ACCEPTANCE ACROSS SCHOOL RANKINGS

- The candidates who have graduated but with less work experience are more likely to apply for DKU programs
- These people are more confident about their GPA although the rankings of their universities vary a lot
- Engineering students are more interested

(%)

Status of candidates	**Undergraduates**			**Graduates**			
Total	40			60			
Interested* (Base=158)	31			69			
School Ranking	**Top10**	**Top20**	**Top30**	**Top50**	**Top100**	**Top200**	**others**
Total	20	9	8	15	19	8	22
Interested (Base=158)	22	10	6	13	19	7	24
GPA	**4.0**	**3.7**	**3.3**	**3.0**	**2.7**	**2.3**	**2.0**
Total	21	41	24	8	3	1	1
Interested (Base=158)	28	37	27	5	1	1	1
Master they currently study	**Science**				**Engineering**		
Total	67				33		
Interested (Base=158)	62				38		
Master they plan to Study	**Science**		**Engineering**		**Economics**		**Others**
Total	50		28		13		9
Interested (Base=158)	51		28		11		9

All respondents base=480
Ref: Q4, Q21R2, Q26R1, Q12R1, Q15

Red figures: the percentages larger than average
*Interested: respondents selecting 'definitely apply for' ECE or IDS program in Q59

FACTORS INFLUENCING THE PERCEPTION

Two characteristics can be observed that affect the perception of the DKU programs

Plans to come back to China vs. staying in the US

- Students' **plans where to live and work** after graduation **greatly affect** their perception of the DKU program

"I wish I could work in the US after graduation. My major is Computer Science and I think US provides the best environment." – 4th year student, Beijing

- Those who have **concrete plans to come back** to China either right after graduation or after a couple of years tend to be **more interested** in the DKU program
- Students who are planning on **staying abroad** are more likely to choose a program with 2 years abroad

Studying abroad to reach their goals vs. a part of their life journey

- Some students have a very determined career path that includes studying abroad to develop a specific skill set or be able to network
- Others see studying abroad more as part of their journey to broaden their horizon, become independent from their parents, and get to know other cultures

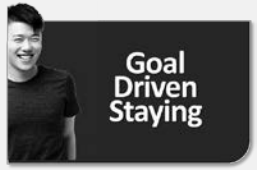
"I would like to go abroad and see the world. I want to have a life experience of living abroad by myself, which will make me become more independent." – 2nd year student, Guangzhou

STUDENTS CAN BE CLUSTERED INTO THREE GROUPS

Plan to Stay in U.S.

Plan to return to China

Group 3: Goal Focused Students with Plans to Stay in the US



Characteristics:

- Have very specific goals for their educational path and future career
- See U.S. as the best environment to be educated in a specific field

40%

Group 2: Goal Focused Students with Plans to Come Back to China

20%

Characteristics:

- Seeking a skill set that will bring advantages in the Chinese job market
- Consider a set of majors that can complement their undergrad degree

Group 1: Journey Focused Students with Plans to Come Back to China

Characteristics:

- Overseas education as a general advantage in the Chinese job market
- Benefits besides education: Experiencing a foreign culture and becoming independent

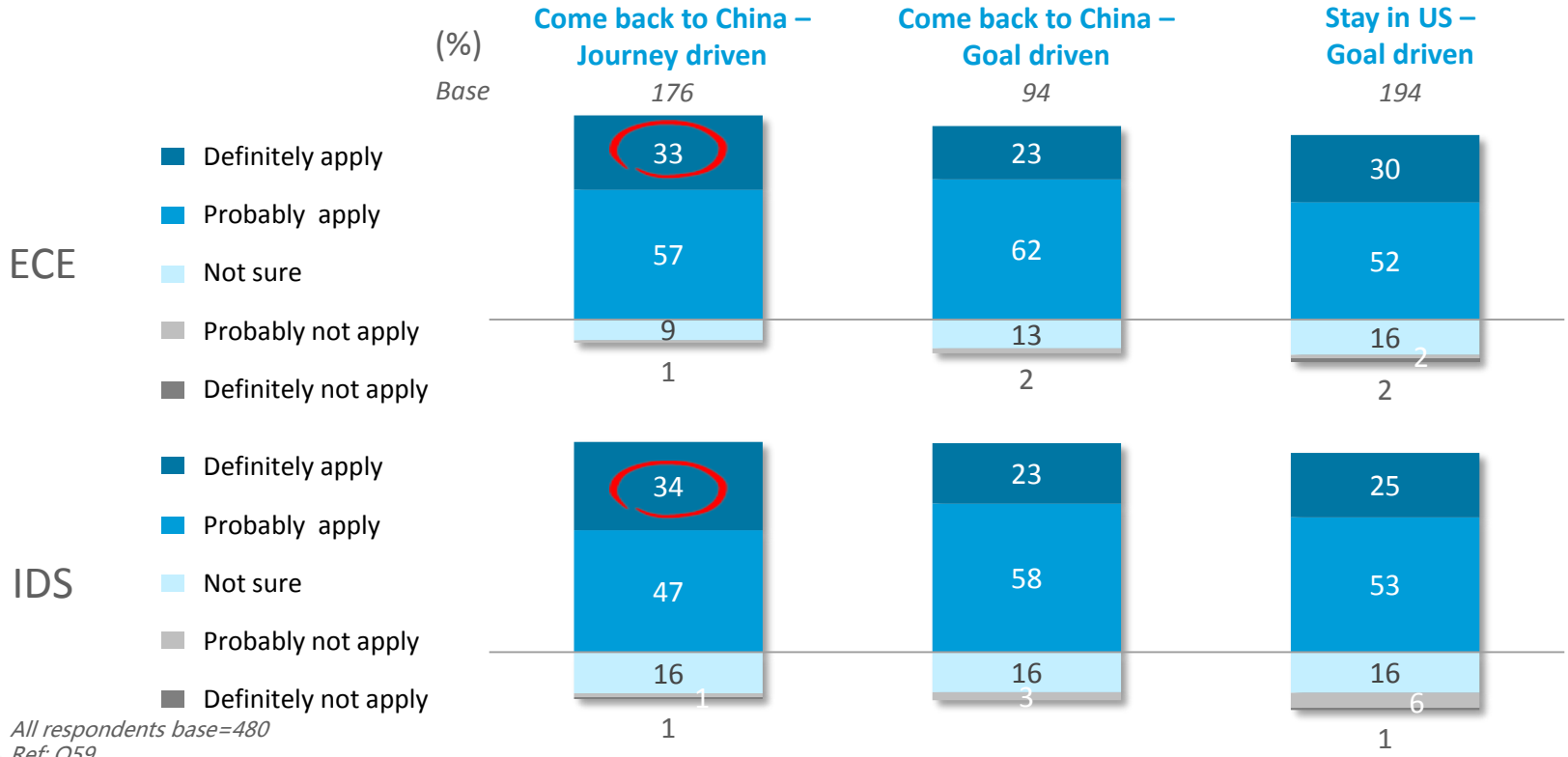
37%

Goal Driven

Journey Driven

GROUP 1 MOST LIKELY TO APPLY

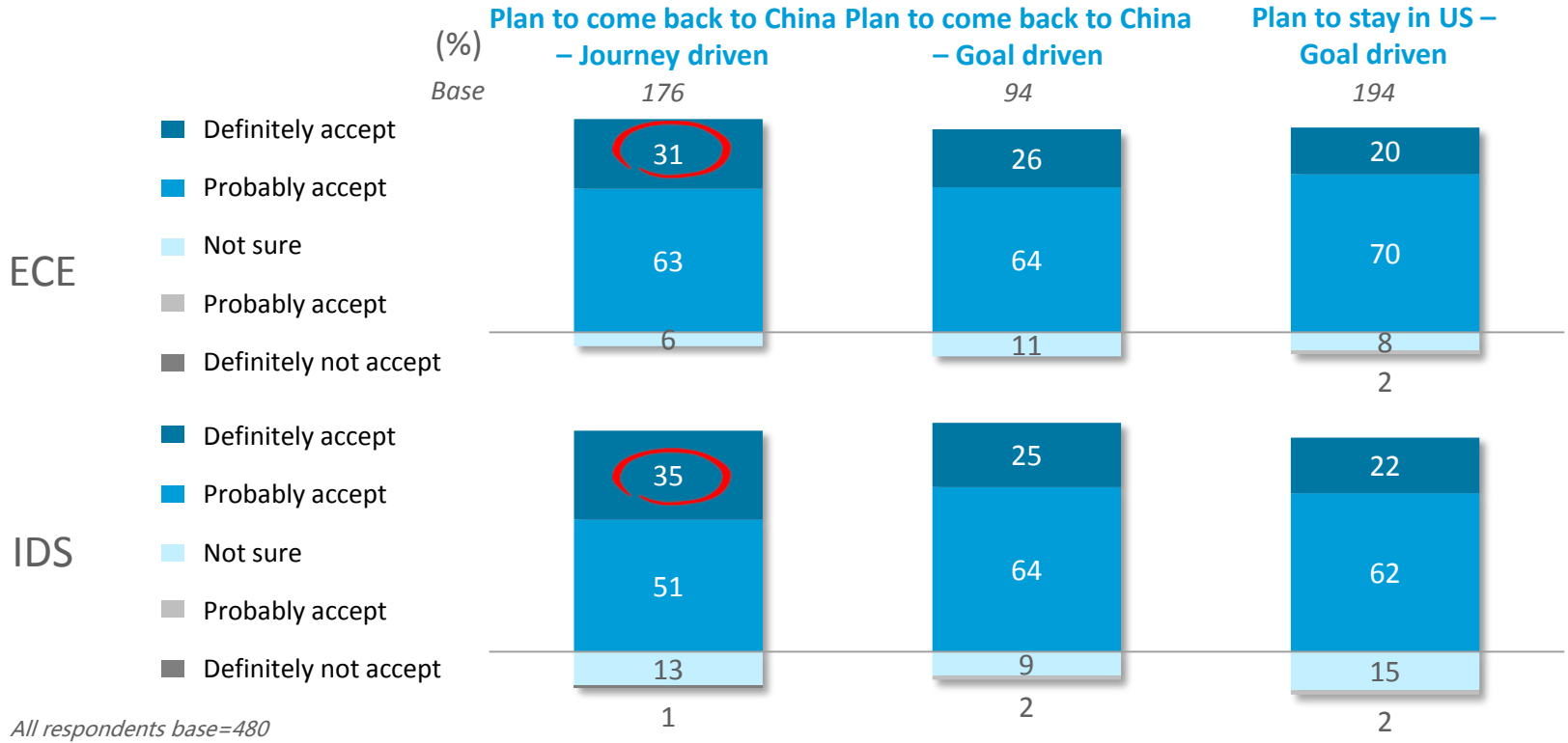
- Journey-driven students with plans to return are most likely to apply for DKU programs (considering the application fee of $75), whichever the major is



All respondents base=480
Ref: Q59

GROUP 3 IS LEAST LIKELY TO ACCEPT AN OFFER

- Most students who are interested in applying claim to accept an offer as well



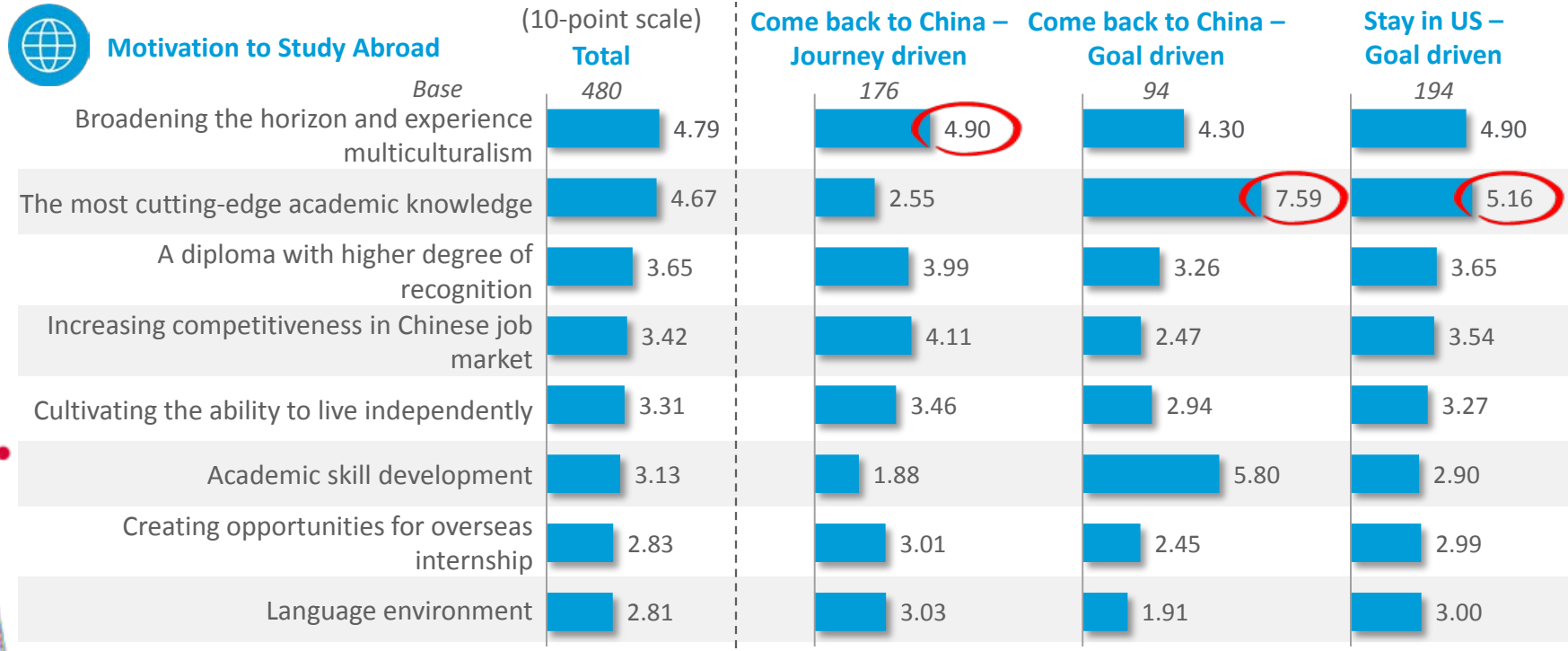
All respondents base=480
Ref: Q60

EXPECTATIONS TOWARD MASTER'S PROGRAM AND DECISION MAKING PROCESS

昆山杜克大学
DUKE KUNSHAN UNIVERSITY

SEEKING EXPERIENCE VS. GAINING KNOWLEDGE

- Multicultural experience and cutting-edge academic knowledge are top 2 motivations to study abroad
- Goal-driven respondents concentrate on academic purpose while journey driven respondents cares more about experience



All respondents base=480
Ref: Q28a

TEACHING QUALITY IS THE TOP PRIORITY

- Teaching quality is the top priority for all respondents to select a university
- Those who are coming back are also concerned about the university's reputation, among which the goal-driven students are attracted by the internship opportunities. Those with plans to stay overseas care more about rankings rather than reputation and internship

Decision Factors (10-point scale)

	Total	Come back to China – Journey driven	Come back to China – Goal driven	Stay in US – Goal driven
Base	*480*	*176*	*94*	*194*
Teaching quality	4.13	4.16	4.24	4.02
University's reputation	3.52	3.14	4.00	3.53
Comprehensive ranking	3.45	3.11	3.27	3.85
Major ranking	3.22	2.48	3.48	3.82
Security of the city	2.88	2.49	3.57	2.68
Curriculum setting	2.64	2.52	2.36	2.74
Internship offered by the university	2.58	2.36	3.70	2.37
Career guidance	2.38	2.48	2.57	2.22
Scholarship	2.33	2.10	2.61	2.24
Campus facilities	2.33	2.43	2.66	2.19
Surroundings of the university	2.06	2.41	1.66	2.02

All respondents base=480
Ref: Q30b

FOCUS ON EXPERIENCE ABROAD

More specific expectation about experience rather than educational goals

Motivation to Study Abroad

- Overseas education is seen as a **general advantage in the Chinese job market**
- Benefits besides education include:
  - Experiencing a **foreign culture**
  - Becoming **independent**
- **Some have concerns** about:
  - Independent life abroad
  - Language capabilities
  - Cultural difference

"I will encounter a language barrier at the beginning. This makes me feel less likely to make friends, because you are afraid […] in a new environment." – 2nd year student, Guangzhou

Educational Goals

- Have **less specific goals** for their educational path and future career
- **Consider various majors** for their master degree that can be different from their undergrad major
- Some have chosen a major that is considered a **safe choice** rather than something they would like to do in their future career

Decision Factors

- Degree recognition: To ensure their **degree is recognized** by future Chinese employers, they tend to prioritize overall school ranking over specific major ranking
- School Location: Their requirements for the school location are driven by considerations of safety and convenience
- Soft Factors: Consider factors such as environment of the university and social activities when choosing a university

"People will not pay too much attention to your major. What they are looking for when you find jobs is the name of the school on your diploma. […] I also consider the location because I prefer a convenient place." – 3rd year student, Shanghai

SEEKING A SPECIFIC SKILL SET

More clear goals for education and future career path

Motivation to Study Abroad

- They are seeking a skill set that will bring **advantages in the Chinese job market**
- This includes:
  - A more practically oriented education
  - Language skills
  - Cultural understanding

"I feel that when some companies recruit employees in China, candidates who have overseas experience will be preferred." – 3rd year student, Hangzhou

Educational Goals

- They have **more specific goals** for their educational path and future career
- Consider a **smaller set of majors** that can **complement** their **undergrad** degree

"I care more about major ranking, because I wish I can enhance my speciality of my major. My undergrad major is different than my postgrad major, so I wish I could get more professional skills through the study of the Mater's program." – 4th year student, Shanghai

Decision Factors

- Overall School Ranking: With a degree from a well-known university it will be **easier to find a job in China**
- Major Ranking: With a high ranking major they want to make sure that the **education quality is good**
- Curriculum: Courses which can **complement** the knowledge they gained during **undergrad studies**
- Career Resources: Appreciate career resources of the university, e.g. **internships in cooperating companies**

US AS THE BEST ENVIRONMENT

See the US as the best environment to get the specific education they aspire

Motivation to Study Abroad

- An education abroad can offer a perceived **better quality:**
  - More experienced faculty
  - Famous alumni
  - Better connection to companies
- They see the US as the **best environment to be educated** in a specific field, e.g. in CS or ECE
- Some have plans to **apply for PhD**

"I have thought about resources in China, but I think the academic environment for Computer Science & Technology in China is not very good.
– 3rd year student, Guangzhou

Educational Goals

- Have **very specific goals** for their educational path and future career, e.g. becoming a top talent in their specific field and working for a big technology company or startup
- They tend to choose a **master program that matches their undergrad**, e.g. Electrical Engineering and Computer Science

"I applied for different majors that are relevant to computer software but have slight differences."
– 4th year student, Guangzhou

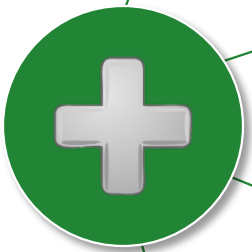
Decision Factors

- Rankings: Their main criteria for school choice are the rankings
- Curriculum: Next they pay close attention to the curriculum and the faculty to make sure it includes the **specific contents** they want to learn and ensure meeting their **educational goals**
- School Location: Their requirements for school location are driven by location of **desired employers** for internships and jobs after graduation

PERCEIVED BENEFITS & BARRIERS OF THE DKU PROGRAMS

昆山杜克大学
DUKE KUNSHAN UNIVERSITY

OVERVIEW OF BENEFITS & BARRIERS

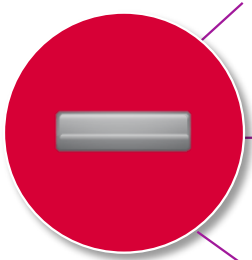


Career Resources
- Career resources in China set the DKU programs apart from others

Scholar-ship
- Being able to receive a scholarship as international student

Duke Education
- Being able to receive a degree from a school that ranks # 8 in the US

Transition Phase
- Adjusting to the American teaching system
- Mainly appealing to parents



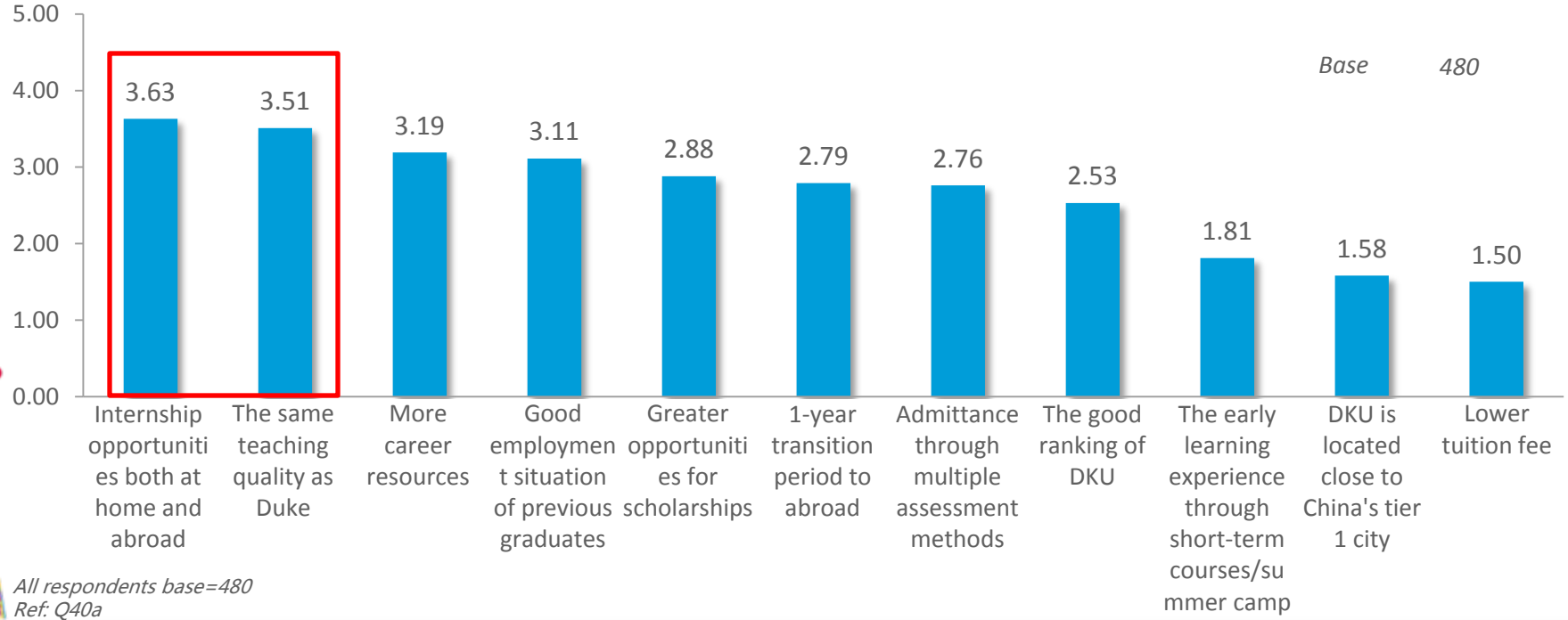
Education Quality
- Same quality education and university resources as in Duke US

DKU Reputation
- Low awareness of DKU
- University hasn't built a reputation yet

Int. Experience / Net-working
- Lack of international experience and networking opportunities during the first year

OVERALL BENEFITS OF THE PROGRAM

- Overall, the internship opportunity both at home and abroad is the greatest benefit of DKU program, followed by the same teaching quality of Duke University
- Besides, more career resources and good employment situation are second important benefits, which means emphasis should be put on career services



All respondents base=480
Ref: Q40a

KEY BENEFITS FOR THE MAJORITY

The top benefits that appeal to most are career resources and a Duke education

Career Resources

- Career resources provided by the university is one of the **most important benefits**
- What sets it apart from other programs are **internship and job opportunities in China**

"It is attractive to me if the university can provide me with career resources. […] These opportunities may be helpful for the application of future internships when you study abroad."
- 3rd year student, Hangzhou

- However, this is not a benefit most students will think of by themselves. They **need to be educated** about how they can benefit from the university's career resources, then it is seen as a major benefit

Duke Education

- Being able to receive a degree from a school that **ranks # 8** in the US is very attractive
- Many students aspire to a degree from a school that has a **high awareness and good reputation in China** and the US as well

"I did some research previously and I prefer the global ranking. Duke University ranks the 8th in the US so its global ranking will not be that bad. I would consider going to this university."
- 3rd year student, Shanghai

- An additional campus in China is perceived as an increased chance to get admitted to Duke

"If a student does not have a strong background, [DKU] is a good way for him/her to get a degree."
- 4th year student, Shanghai

KEY BENEFITS TO SOME

Reduced scholarship is attractive to some and transition phase appeals to parents

Scholarship/Tuition

- Depending on their personal situation and opinion, **reduced tuition cost** or being able to **get a scholarship** as an international student is attractive to students from different backgrounds and to parents

"I think it is more attractive to communicate being able to offer scholarship and it is less attractive to communicate that it is cheaper to study at home for the first year."
– 2nd year student, Guangzhou

"My parents fully support me, but I am quite concerned and I do not want to spend too much money for tuition fees."
- 3rd year student, Shanghai

Transition Phase

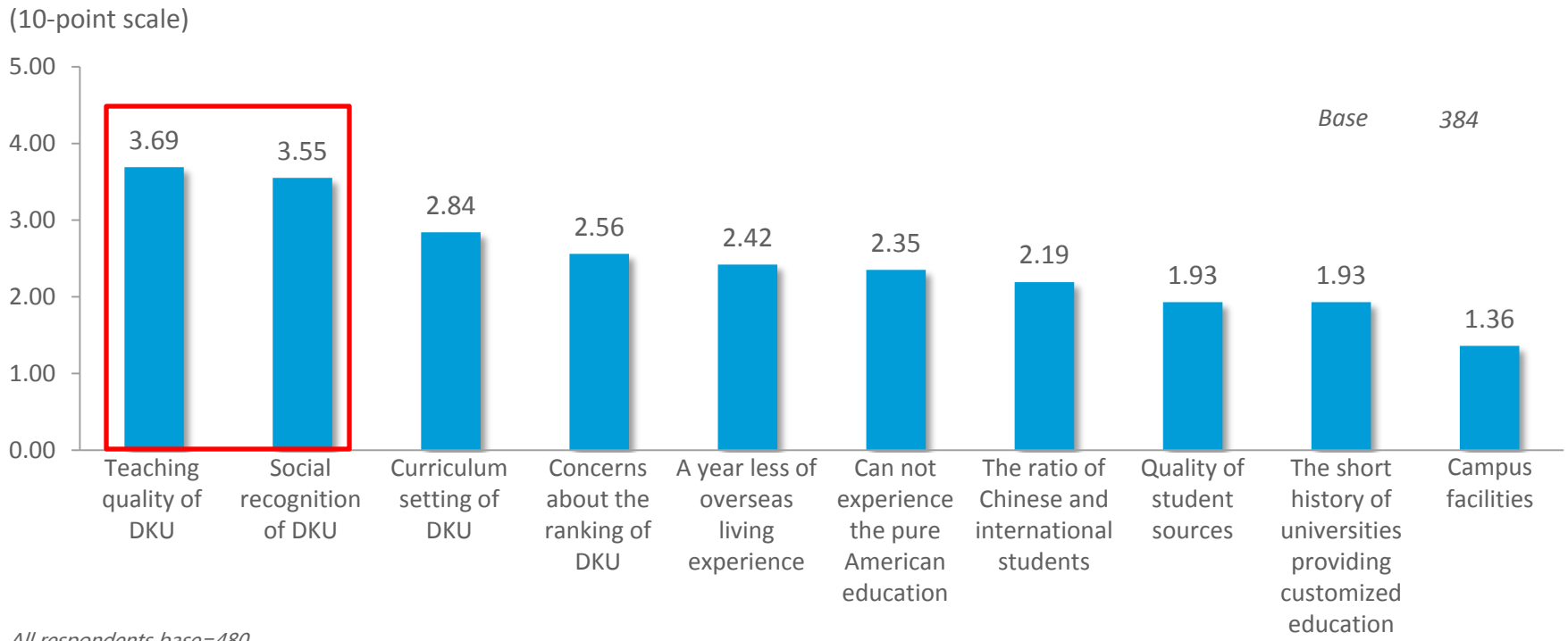
- Especially parents appreciate a transition phase for their child in the first year
- The benefits include the ability to adjust to the American teaching system, the language and the culture as well as having their children nearby

"I think [a transition period] is easier for students than going abroad directly to experience the advanced technology, teaching philosophy and studying environment from abroad already in the first year. "
- Parent, Shanghai

"It is attractive to parents, because the first year is in China and parents could see their child. Parents will feel safe, because China is safer than foreign countries. "
- Parent, Hangzhou

OVERALL BARRIERS OF THE PROGRAM

- The teaching quality and social recognition of DKU are the main concerns, followed by its curriculum settings



All respondents base=480
Ref: Q40a

KEY BARRIERS OF THE PROGRAM

Equal education quality of DKU is a key concern across groups

Education Quality and University Resources

- The main motivation to study abroad is the perceived difference in education style with a **more practically oriented curriculum**
- Therefore the biggest concern across students and parents is the **quality of education during the first year** in DKU compared to Duke
- Some students want to understand if DKU has received a **ranking that is comparable to Duke** in order to prove it is a program of equal quality

"DKU is set up in a Chinese environment, like a Chinese branch, so I feel it is difficult for DKU to reach the standard of Duke University."
– 3rd year student, Hangzhou

International Experience/ Networking

- One reason for education abroad is gaining international experience.
- Therefore some students as well as parents are concerned that during the first year in China students aren't able to make the **same international experience** or be able to **network with international students** compared to the US
- They want to know how many international students are studying in the same program or at the DKU campus

"If the first year is in China, my idea would be: although I go to an English school, the people that I know are all Chinese and I will talk about the same topics every day."
– 3rd year student, Shanghai

KEY BARRIERS OF THE PROGRAM – CONT'D

Due to DKU's low awareness students fear a lack of social recognition of their degree

DKU Awareness and Reputation

- The **awareness of DKU** amongst students and parents is **quite low**, therefore it hasn't built up a reputation yet
- One factor is the **unclear status of DKU campus** as a joint venture with a Chinese university or full branch campus of Duke, which is links back to the perception of education quality and reputation in China
- Especially in the East some students have **reservations regarding joint venture programs**. A branch campus, such as Shanghai NYU, has a better reputation than a joint venture school, e.g. Ningbo Nottingham
- Other uncertainties exists regarding their status as Duke students:
  - Will they be **considered students of Duke** although they study at the DKU campus
  - How others will perceive their status
  - If **future employers** know about DKU and what is the perceived reputation

"DKU was set up in 2004. What is the relationship between Duke University and DKU? Is DKU the branch of Duke University?"
– Parent, Shenzhen

"Good universities establish a school that admits the students who possess strong financial resources. I have the same impression of DKU."
– 3rd year Student, Hangzhou

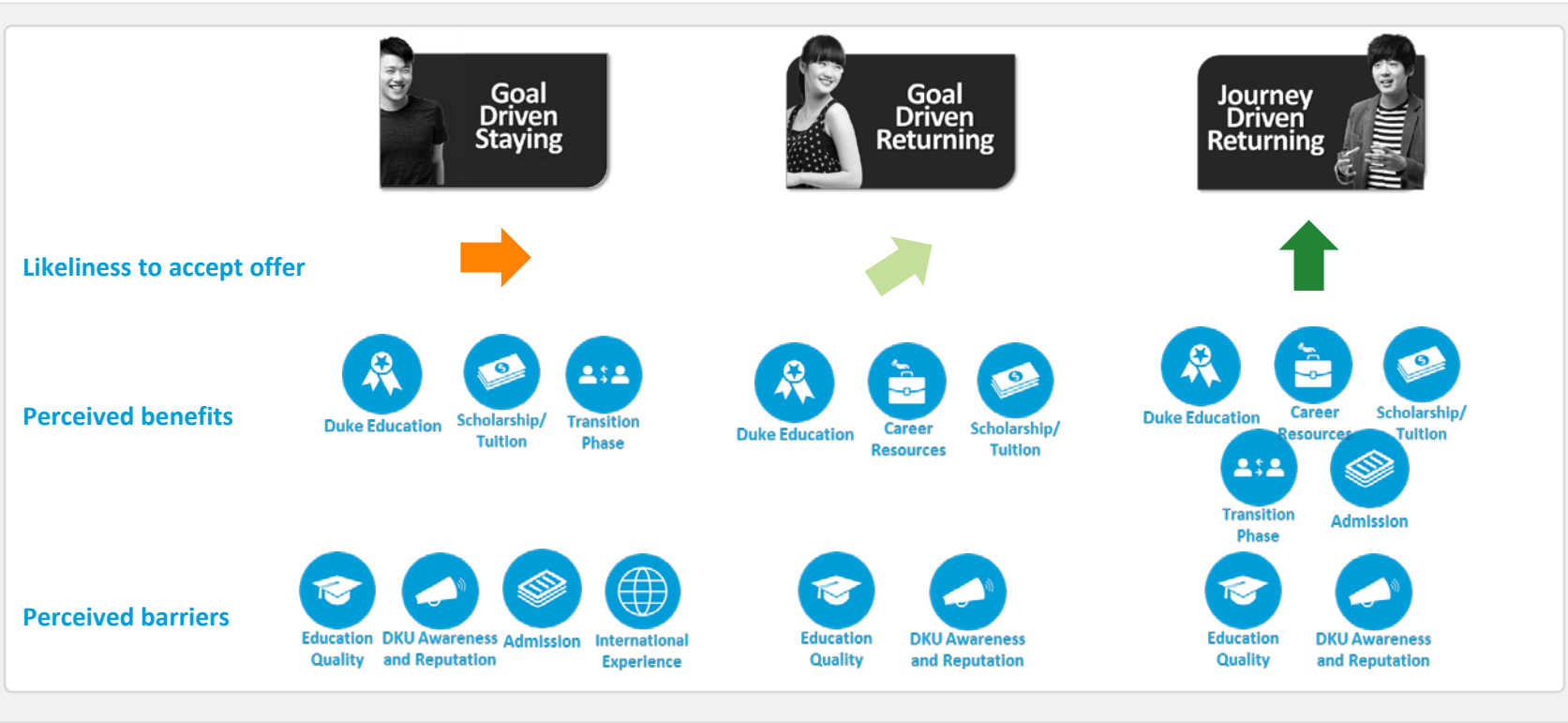
"If a student tells his classmates that he will study abroad but it turns out he actually spends one year in China, they may question whether the teaching quality and the quality of the diploma will be the same."
– Parent, Shenzhen

PERCEPTION OF THE DKU PROPOSITION AMONGST STUDENTS

昆山杜克大学
DUKE KUNSHAN UNIVERSITY

PERCEIVED BENEFITS & BARRIERS

Likeliness to apply depends on how many benefits and barriers they perceive



FOCUSED MAINLY ON THE FIRST STEP

- Journey driven student with plans to come back to China focus most on the first step, the university itself
- This includes teaching quality and university reputation; they care less about the next step, their future career

(10-point scale)

Decision factors

Base 176

Teaching quality	4.16
University's reputation	3.14
Comprehensive ranking	3.11
Curriculum setting	2.52
Security of the city	2.49
Major ranking	2.48
Career guidance	2.48
Campus facilities	2.43
Surroundings of the university	2.41
Internship offered by the university	2.36
Scholarship	2.10

Benefits

Base 176

The same teaching quality as Duke	3.67
Internship opportunities both at home and abroad	3.40
More career resources	3.20
Good employment situation of previous graduates	3.10
Admittance through multiple assessment methods	2.89
Greater opportunities for scholarships	2.60
1-year transition period to abroad	2.54
The good ranking of DKU	2.40
The early learning experience through short-term courses/summer camp	2.00

Barriers

Base 130

Teaching quality of DKU	3.17
Social recognition of DKU	3.03
Curriculum setting of DKU	3.00
The ratio of Chinese and international students	2.75
Concerns about the ranking of DKU	2.73
A year less of overseas living experience	2.59
The short history of DKU	2.11
Can not experience the pure American education	2.10

All respondents base=480
Ref: Q30b, Q39a, Q40a

ATTRACTED BY MOST OF THE BENEFITS

This group is the most likely to apply to DKU and accept an offer

Plan to come back to China – Journey driven

- They are attracted by Duke's **university ranking** and appreciate the opportunity to receive a **degree from a top US university** that is well known in China
- Another attraction point is **career resources in China** due to their plans to come back after graduation
- Depending on their family's financial situation some are attracted by lower tuition fee or scholarship as well
- Some appreciate the opportunity to experience **studying in both countries** and being able to connect with students in China and the US. Especially those who have concerns about their English capabilities and adapting to a foreign culture appreciate the **transition period**
- Some hope it will be easier to get admitted to DKU than Duke
- On the other hand they have concerns about the education quality of the first year in China and the reputation of DKU in China

PLAN AHEAD TO THE NEXT STEP: THEIR CAREER

- Teaching quality and reputation is still important, but these goal-driven students are more likely to be attracted with the advantageous career services, because they have clear plan in a longer term

(10-point scale)

Decision factors

	Base 94
Teaching quality	4.24
University's reputation	4.00
Internship offered by the university	3.70
Security of the city	3.57
Major ranking	3.48
Comprehensive ranking	3.27
Campus facilities	2.66
Scholarship	2.61
Career guidance	2.57
Curriculum setting	2.36
Surroundings of the university	1.66

Benefits

	Base 94
Internship opportunities both at home and abroad	3.56
More career resources	3.13
The same teaching quality as Duke	3.10
Admittance through multiple assessment methods	3.10
Good employment situation of previous graduates	2.99
Greater opportunities for scholarships	2.90
1-year transition period to abroad	2.44
The good ranking of DKU	1.74
The early learning experience through short-term courses/summer camp	1.63

Barriers

	Base 80
Social recognition of DKU	3.93
Teaching quality of DKU	3.31
Curriculum setting of DKU	3.14
Can not experience the pure American education	2.33
A year less of overseas living experience	2.13
Concerns about the ranking of DKU	2.05
The ratio of Chinese and international students	1.68
The quality of student sources	1.64

All respondents base=480
Ref: Q30b, Q39a, Q40a

POTENTIAL CANDIDATES WITH FEWER BENEFITS

Due to their clearer education and career plans they have more doubts

Plan to come back to China – Goal driven

- This group has potential to be attracted by DKU, because they value **career resources in China** and consider the **overall school ranking** to a certain extent
- Although they are still willing to pay more for a foreign education, a **lower tuition fee** might outweigh some of the concerns they have
- They don't need a transition period to adapt to the American system, but some appreciate networking opportunities with Chinese and American classmates
- Top concern is quality of education during the first year in DKU, which is mainly driven by doubts about the **equal qualification of professors and course settings**
- Those that have reservations about joint venture schools fear that the admission standards will be lower than in the US, which can impact the **reputation the degree has in China**
- Others that are open towards joint venture or branch campuses are still concerned about the **low awareness of DKU** amongst Chinese companies

STRONGEST CONCERNS ABOUT TEACHING QUALITY

- With plans to stay overseas, social reputation is no longer the main concern. They prefer universities with high teaching quality and rankings, as well as internship opportunities conducive to stay longer
- In addition, they hope DKU will help them smoothly transit to abroad

(10-point scale)

Decision factors

Base 194

Teaching quality	4.02
Comprehensive ranking	3.85
Major ranking	3.82
University's reputation	3.53
Curriculum setting	2.74
Security of the city	2.68
Internship offered by the university	2.37
Scholarship	2.24
Career guidance	2.22
Campus facilities	2.19
Surroundings of the university	2.02

Benefits

Base 194

Internship opportunities both at home and abroad	4.01
The same teaching quality as Duke	3.51
1-year transition period to abroad	3.37
More career resources	3.27
The good ranking of DKU	2.98
Good employment situation of previous graduates	2.96
Greater opportunities for scholarships	2.93
Admittance through multiple assessment methods	2.66
DKU is located close to China's tier 1 city	1.89

Barriers

Base 160

Teaching quality of DKU	4.21
Social recognition of DKU	3.67
Curriculum setting of DKU	2.75
Can not experience the pure American education	2.71
Concerns about the ranking of DKU	2.68
A year less of overseas living experience	2.58
The ratio of Chinese and international students	2.01
The quality of student sources	1.96

All respondents base=480
Ref: Q30b, Q39a, Q40a

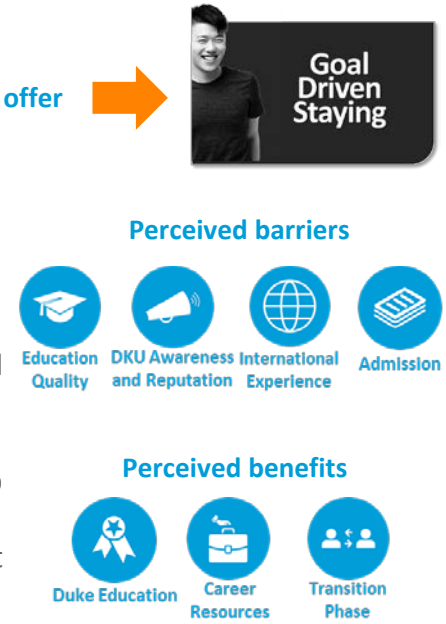
CONCERNS OUTWEIGH BENEFITS

They see some benefits in career resources and transition, but have strong concerns

Plan to stay in US – Goal driven

- This group is the least likely to apply to DKU, because they have the **strongest concerns, which outweigh the benefits**
- Concerns about education quality are the biggest for this group due to their specific educational goals
- They fear that the **admission standards will be lower** than for the pure US program and the environment will be **less challenging** for them, which might impact their ability to receive the best education possible
- **Missing out on an international environment** and the chance to network is an additional concern for these students, who see the time in the US as part of their education

- They see some benefits in the ability to **get internships in both countries**, which can help with future job opportunities
- If the teaching quality is acceptable, a transition phase could help some of them to adjust to the American teaching environment
- They are **strongly driven by rankings**, therefore Duke's university ranking is a benefit



PERCEPTION OF THE DKU PROPOSITION AMONGST PARENTS

ADVISORS RATHER THAN DECIDERS

The role of the parents

- Parents have a **rather advising role** than participating in the decision making process
- They do their own research and then pass the information to their children, e.g. **creating awareness** and consideration of a specific program
- The **level of influence depends** on the age of the students and on the background of the parents:
  - The younger the students are the more influence the parents have
  - The better the education background of parents is the more they tend to get involved

Perception of DKU programs

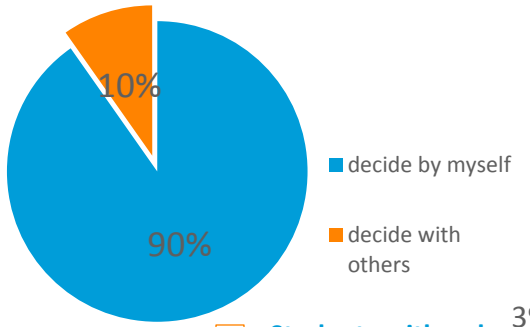
- In general parents tend to have a **more positive perception** of the proposition for DKU master's programs
- They respond well to the main benefits of career resources in China, lower tuition fee and scholarship opportunities as well as the overall university ranking
- Especially parents with daughters have concerns about **the safety in foreign countries** and would appreciate to have their **child closer** to themselves in the first year
- The opportunity of a **transition year** to get used to the American teaching system and culture seems to be a benefit that is more appealing to parents rather than students

MORE INFLUENCE ON YOUNGER STUDENTS

- 90% of all the students are the main decision-makers of studying abroad, and almost all the students with related majors determine by themselves.
- A higher proportion of undergraduates make decision with their parent or others (15%), but the parents take a less important role after they graduate from the university (decreasing to 7%)

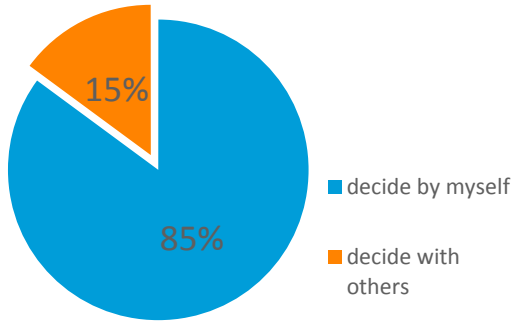
(%) **Students considering studying abroad**

Base 2102



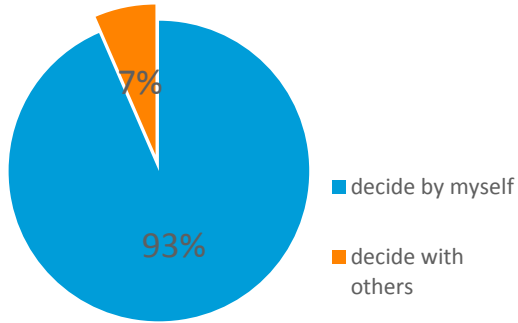
Undergraduates

Base 812



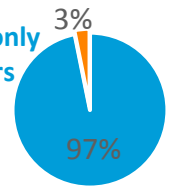
Graduates

Base 1290



Students with only related majors

Base 346



Students considering studying abroad base=2102
Ref: Q30b, Q39a, Q40a

PARENTS MORE DRIVEN BY COST ASPECTS

- The main 3 attraction points of DKU programs include the good ranking of DKU, greater opportunities for scholarships and the same teaching quality as Duke
- Financial issues are significantly more of a concern for parents, although the lower tuition fees is not regarded as one of the top benefits. Instead, they hope to decrease the expenditure in forms of scholarship, which is more important than career services the university could offer

(10-point scale)	Total	Students	Parents
Base	*480*	*346*	*134*
Internship opportunities both at home and abroad	3.63	3.85	3.04
The same teaching quality as Duke	3.51	3.50	3.53
More career resources	3.19	3.28	2.98
Good employment situation of previous graduates	3.11	3.06	3.23
Greater opportunities for scholarships	2.88	2.60	3.61
1-year transition period to abroad	2.79	2.69	3.04
Admittance through multiple assessment methods	2.76	2.87	2.48
The good ranking of DKU	2.53	2.10	3.63
The early learning experience through short-term courses/summer camp	1.81	1.76	1.93
DKU is located close to China's tier 1 city	1.58	1.45	1.89
Lower tuition fee	1.50	1.32	1.98

All respondents base=480
Ref: Q40a

QUALITY OF FELLOW STUDENT MATTERS

- Parents have much in common with students regarding the main barriers of applying for DKU-teaching quality, social recognition and curriculum setting of DKU
- However, great importance has been attached on who will study with their children. Parents pay attention to the ratio of Chinese students and the quality of student sources, which the students themselves feel less important

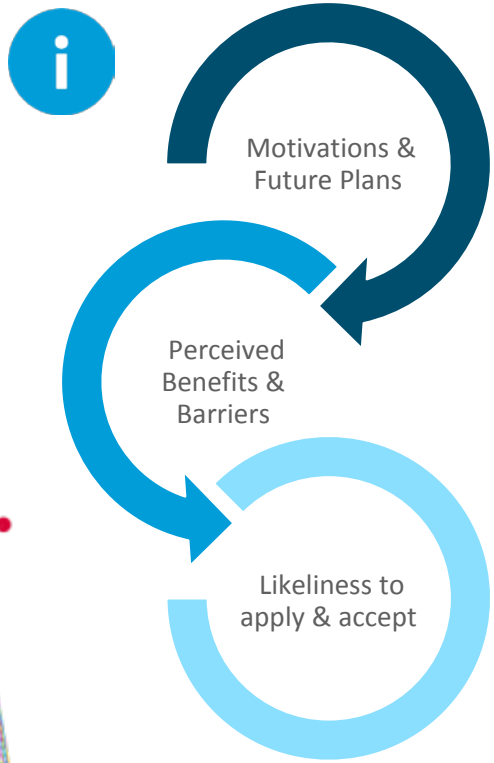
(10-point scale)	Total	Students	Parents
Base	*384*	*281*	*103*
Teaching quality of DKU	3.69	3.62	3.88
Social recognition of DKU	3.55	3.29	4.27
Curriculum setting of DKU	2.84	2.69	3.26
Concerns about the ranking of DKU	2.56	2.35	3.14
A year less of overseas living experience	2.42	2.62	1.87
Can not experience the pure American education	2.35	2.66	1.50
The ratio of Chinese and international students	2.19	1.81	3.23
The quality of student sources	1.93	1.57	2.90
The short history of universities	1.93	1.91	1.97
Campus facilities	1.36	1.51	0.96

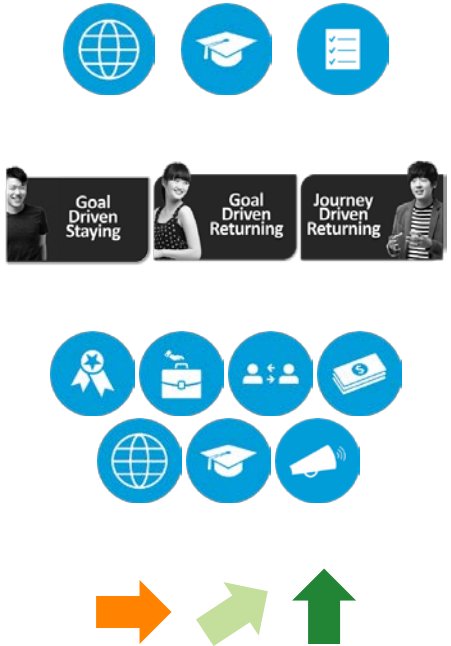
All respondents base=480
Ref: Q40a

COMMUNICATION MESSAGES

IMPORTANCE OF MARKETING COMMUNICATION

Potential student number is closely linked to contents, credibility and success of the communication





The three types of students have different motivations for a foreign education and plans for their future

➢ **Understand & target different student groups**

All three groups are attracted by certain benefits and the different barriers have more or less impact on their decision

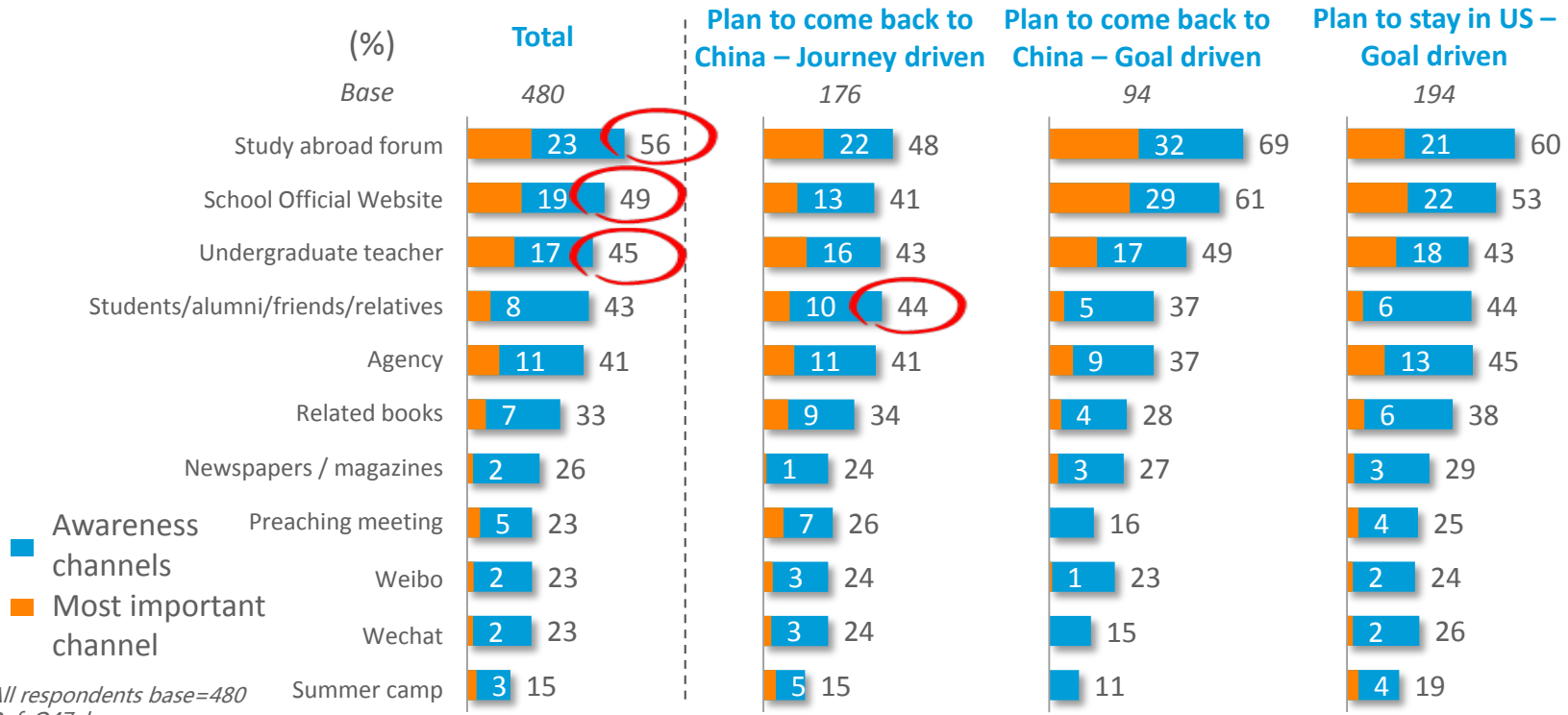
➢ **Communicate the right messages**

Create awareness through the right channels, communicate benefits and address barriers

➢ **Increase likeliness to apply and accept**

ONLINE SOURCES ARE THE MOST COMMON

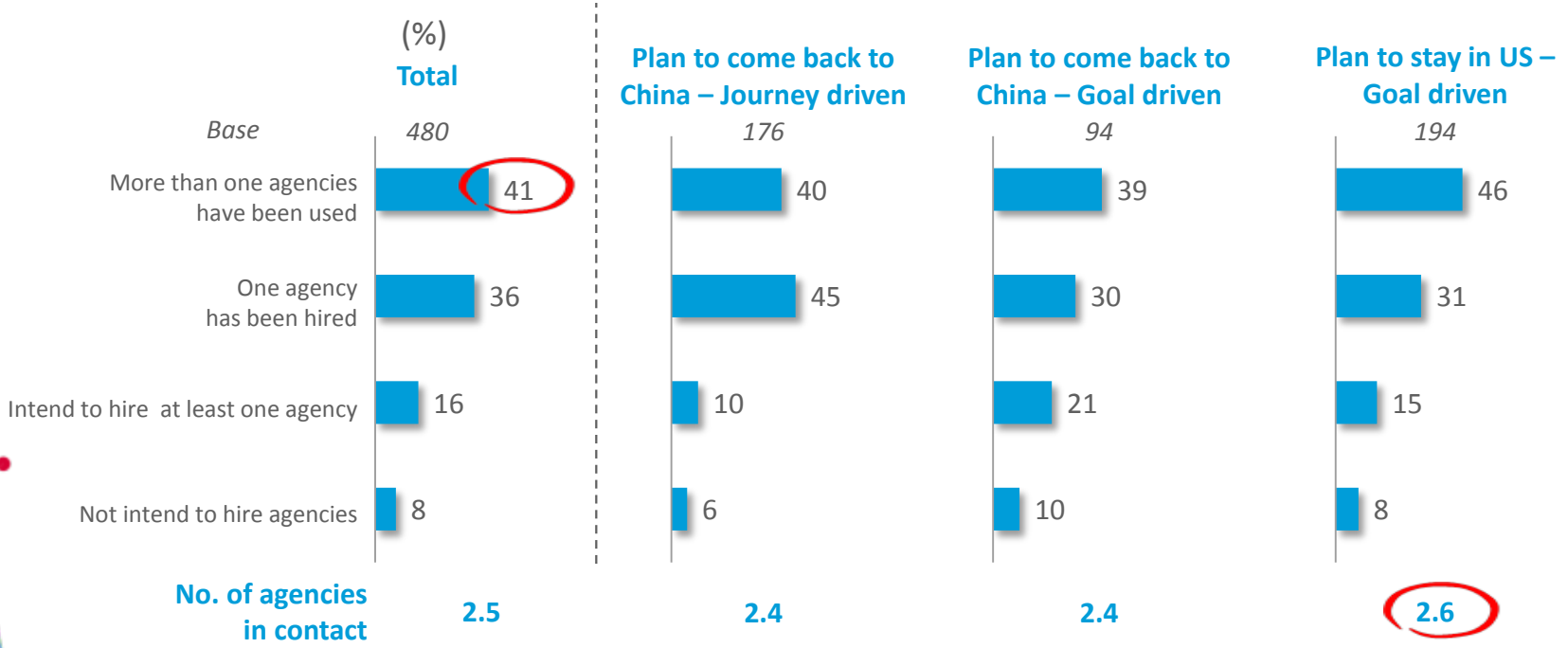
- In order to know about postgraduate programs in USA and Europe, the study abroad forums are the most widely-used and important channels, followed by universities' official websites and undergraduate teachers
- For group 1 students, recommendation from relatives and friends is the second most common way to obtain related information



All respondents base=480
Ref: Q47ab

MOST OF THE STUDENTS USE MULTIPLE AGENCIES

- Above 40% of respondents have hired more than one agency. On average, these people will contact 2-3 agencies to decide which one to hire. Those who intend to stay overseas are relatively more connected to agencies



All respondents base=480
Ref: Q48, Q49

CREATE AWARENESS FOR DUKE DEGREE

Making these students aware of the offer is the most important step

Duke Education

Create awareness at early stage and emphasize full Duke degree

- Since they have less specific goals for their educational path, **creating awareness for the DKU programs** and the opportunity of receiving a **degree from Duke** at an **early stage**, e.g. in their sophomore year, is the most important step to attract this group
- Receiving a **full Duke degree with the same ranking as in the US** needs to be emphasized

Benefits to be communicated

Career Resources

Clarify what career resources DKU can offer in China

- **Name cooperating companies** and introduce which **job opportunities** can be achieved after graduation
- Endorse these messages with **statements from DKU graduates** about their experiences during and after the program and what benefits attracted them

Transition Phase

Provide more information about how the transition will be achieved

- E.g. language courses, interaction with professors and students, cultural courses

Admission

Explain DKU's ability to screen applicants more carefully due to proximity to Chinese students

- Some perceive increased chances to be admitted to Duke due to **DKU's ability to screen applicants more carefully at their local campus and evaluate skills besides the GPA score**, e.g. in personal interviews or a summer camp program

ENDORSE WITH COMPANY COOPERATION

Provide background information about curriculum and faculty

Barriers to be overcome

Education Quality

Introduce professors and detailed curriculum

- To overcome concerns about the education quality of the first year in China they need more **detailed information about the curriculum and faculty**
- In information sessions they hope to **meet the professors** in person and be convinced about their **background and qualification**

DKU Awareness and Reputation

Reassure social and corporate recognition of DKU in China

- To endorse the reputation of DKU in China they would like to
  - See examples of **company cooperation**
  - Ideally directly hear from **representatives of cooperating companies**
  - Clarify that students are regarded as **students of Duke**

CAREER RESOURCES & EQUAL QUALITY

With their strong career focus they respond to career resources

Career Resources

- Since they have a strong focus on future career they need to hear similar messages:
  - What kind of **companies** DKU cooperates with
  - Where **internships** can be offered
  - What kind of **job opportunities** can be achieved after graduation

Networking

Emphasize international campus setting

- Some appreciate the opportunity to network with Chinese and American classmates

Education Quality

Ensure equality of curriculum and faculty between DKU and Duke

- As this group has **higher requirements toward teaching quality** they need more convincing about the **equality of DKU and Duke**

DKU Awareness and Reputation

Address reservations about reputation of joint venture schools

- Some perceive joint venture schools to have **lower admission standards than in the US**.
- DKU needs to be positioned as an additional campus of Duke, that allows Duke **to increase their capacities** and **admit more talented students from China**

Benefits to be communicated

Barriers to be overcome

RANKING & COMPETITIVENESS

Address the strongest concerns about equal teaching quality

Education Quality

DKU Awareness and Reputation

Admission

International Experience

Communicate university and major ranking and ensure equality of DKU

- They are strongly driven by rankings as a measure of teaching quality and reputation
- They need to be **convinced about all aspects** of equal teaching quality:
  - Same university and major ranking despite one year at DKU
  - Equal curriculum to ensure same content and skills can be learned
  - Faculty with equal background and experience
  - Comparable facilities, e.g. laboratories and libraries

Address concerns regarding lower admission standards and DKU reputation

- High admission standards guarantee the quality of education and fellow students
- An example for an endorsement od DKU's reputation could be an **application system purely through Duke** with an optional admission to DKU on the offer letter

Emphasize international campus setting to ensure competitiveness

- International classmates are perceived to ensure a certain competitiveness, enable to build up a valuable network and create an environment of international mindset

Barriers to be overcome

MESSAGE TO BE COMMUNICATED

Benefits to be communicated

- Create awareness of the programs at an early stage in their planning process
- Leverage channels: websites & forums, agencies, introductions at their universities
- Emphasize full Duke degree and ranking

- Clarify what career resources DKU can offer
- Endorse with company cooperation and alumni from China

- Provide more information about how the transition will be achieved

- Explain DKU's ability to screen applicants more carefully due to proximity to Chinese students

- Advertise scholarship opportunities

Barriers to be overcome

- Ensure equality of DKU teaching quality: Introduce faculty, explain their qualification & background, detailed curriculum and facilities
- Communicate university and major ranking, especially for DKU

- Reassure social and corporate recognition and reputation of DKU in China
- Clarify relationship and purpose of DKU campus to Duke; an additional campus to enable more Chinese talents to attend Duke

- Address concerns regarding lower admission standards and reservations toward JV schools, e.g. with application system purely through Duke

- Emphasize international campus setting to ensure competitiveness, networking opportunities and international experience

COMMUNICATION TO REACH ALL GROUPS

The more messages can be communicated successfully, the more student can be attracted

Benefits to be communicated

Duke Education
Career Resources
Scholarship/ Tuition
Transition Phase
Admission

Duke Education
Career Resources
Scholarship/ Tuition

Duke Education
Scholarship/ Tuition

37%
+20%
+40%

Barriers to be overcome

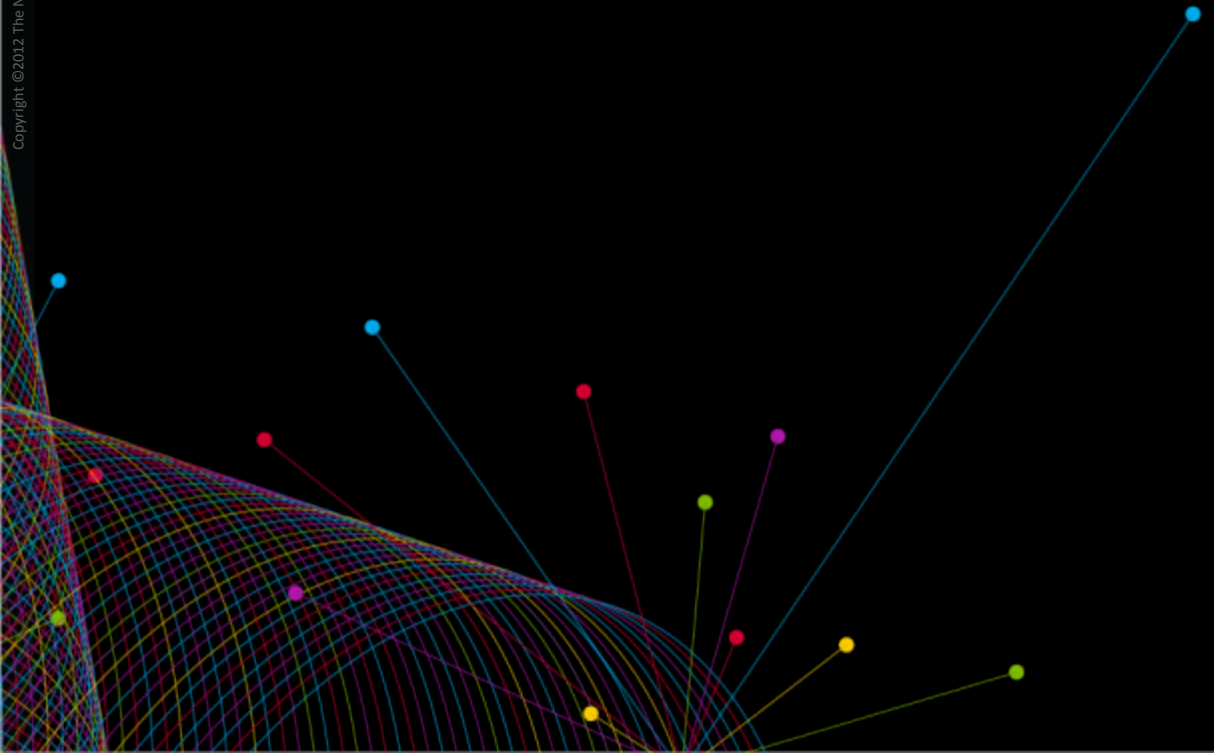
Education Quality
DKU Awareness and Reputation

Education Quality
DKU Awareness and Reputation

Education Quality
DKU Awareness and Reputation
International Experience
Admission

nielsen

AN UNCOMMON SENSE
OF THE CONSUMER™



昆山杜克大学
DUKE KUNSHAN
UNIVERSITY

9.7. Employer Survey

The following questionnaire was sent to the management personnel of a number of international companies and the replies from these companies are summarized.

Questionnaire

Duke University (Duke) and Duke Kunshan University (DKU) plan to build a new master program in Electrical and Computer Engineering (ECE) to recruit top students in China and other neighboring countries, emphasize international experience and contexts, and train students to become global technical leaders. Students will spend the first year at DKU, work in China (e.g., Google China, IBM China, Microsoft China, etc.) for summer internship at the end of the first academic year, and continue to study at Duke during the second year. At the end of the second academic year, students will receive a Duke master degree (single degree) in ECE and will be eligible to apply for OPT and work in U.S. By staying in China for one year and working for summer internship, students graduated from this program are expected to be familiar with the industrial environment and culture in China or other neighboring countries.

In order for us to optimally design this master program, we want to kindly get your valuable inputs on the following questions.

- *Who is your employer and what is your job title?*
- *Do you see any difference between MS (Master of Science) students and MEng (Master of Engineering) students? If you need to recruit a new employee, do you strongly prefer one category over the other? An MS student is expected to take 10 technical courses, while an MEng student is expected to take 8 technical courses + 2 management/business courses taught by the business school.*
- *Do you see any difference between the regular Duke program and this DKU/Duke program? Would you prefer to recruit students from one program over the other?*
- *Do you value the studying/working experience in China? As an international company, do you see any advantage for your employees to be trained by US university with working experience in China?*

Manager, Google, CA, USA

- *Who is your employer and what is your job title?*

I am an Engineering Manager at Google, and involved in hiring decisions for software engineers.

- *Do you see any difference between MS (Master of Science) students and MEng (Master of Engineering) students? If you need to recruit a new employee, do you strongly prefer one category over the other? An MS student is expected to take 10 technical courses, while an MEng student is expected to take 8 technical courses + 2 management/business courses taught by the business school.*

It's the performance in interview matters most. While it's true that a CS or related degree is important to pass screening, but I don't think MS and MEng have a lot difference. But the

curriculum could impact interview performance. For example, we do like job candidates to have strong interpersonal communication skills and leadership skills. If the extra exposure to business/management courses can help students perform better in these areas during their interview process, it would definitely help.

- *Do you see any difference between the regular Duke program and this DKU/Duke program? Would you prefer to recruit students from one program over the other?*

Yes, Duke/DKU would sounds less credible than Duke program does, and that could be an important factor of hiring decision. I would say Duke is a very established program and Duke/DKU is new to me and probably new to many other hiring managers.

- *Do you value the studying/working experience in China? As an international company, do you see any advantage for your employees to be trained by US university with working experience in China?*

We value candidate's experiments equally regardless it's in US or in China. However, experiences with reputable employers will likely weigh more. Same applies to education background. Tracking records of working experiences in top Chinese IT companies would be counted well.

Director, IBM Research, NY, USA

- *Who is your employer and what is your job title?*

IBM, Program Director

- *Do you see any difference between MS (Master of Science) students and MEng (Master of Engineering) students? If you need to recruit a new employee, do you strongly prefer one category over the other? An MS student is expected to take 10 technical courses, while an MEng student is expected to take 8 technical courses + 2 management/business courses taught by the business school.*

Yes, MS students are preferred.

- *Do you see any difference between the regular Duke program and this DKU/Duke program? Would you prefer to recruit students from one program over the other?*

Not sure yet - but mostly we look for matched skills, not particularly from any schools.

- *Do you value the studying/working experience in China? As an international company, do you see any advantage for your employees to be trained by US university with working experience in China?*

We value global experience for sure.

Director, Huawei, NJ, USA

- *Who is your employer and what is your job title?*

Huawei, Director

- *Do you see any difference between MS (Master of Science) students and MEng (Master of Engineering) students? If you need to recruit a new employee, do you strongly prefer one category over the other? An MS student is expected to take 10 technical courses, while an MEng*

student is expected to take 8 technical courses + 2 management/business courses taught by the business school.

Ph.D would be preferred at Huawei US, same for the companies I worked before (Lucent Technologies, Agere, etc.) As for MS vs. Meng, 8 courses with better communication skills would be more useful than 10 technical courses.

- *Do you see any difference between the regular Duke program and this DKU/Duke program? Would you prefer to recruit students from one program over the other?*

Hard to say upfront. It all depends on training, experience and interview feedbacks.

- *Do you value the studying/working experience in China? As an international company, do you see any advantage for your employees to be trained by US university with working experience in China?*

No one could ignore China factor these days, we have been looking for employees who could bring the best experience across US and China.

Senior Research Scientist, Boeing, AL, USA

- *Who is your employer and what is your job title?*

The Boeing Company, senior research scientist

- *Do you see any difference between MS (Master of Science) students and MEng (Master of Engineering) students? If you need to recruit a new employee, do you strongly prefer one category over the other? An MS student is expected to take 10 technical courses, while an MEng student is expected to take 8 technical courses + 2 management/business courses taught by the business school.*

Yes. I prefer MENG students, as our employees are expected to understand not only technical stuff, but management/business in order to execute our projects. In most cases, they also need to have skills to discuss with our customers, internal or external. Basic management/biz skills will be helpful.

- *Do you see any difference between the regular Duke program and this DKU/Duke program? Would you prefer to recruit students from one program over the other?*

I'm not familiar with Duke's program, so I just skip the first question. I don't have a strong preference, both of them are OK. Generally, international Background is a plus.

- *Do you value the studying/working experience in China? As an international company, do you see any advantage for your employees to be trained by US university with working experience in China?*

Yes, as we have increasingly collaboration and business in China. This program has good advantages: Easy to deal with the two cultures, good to communicate with both Chinese and American, better understand Chinese customers and capture market trend, help to improve company's diversity, etc.

Chief Data Scientist, Dell, TX, USA

- *Who is your employer and what is your job title?*

Dell Technologies, Chief Data Scientist

- *Do you see any difference between MS (Master of Science) students and MEng (Master of Engineering) students? If you need to recruit a new employee, do you strongly prefer one category over the other? An MS student is expected to take 10 technical courses, while an MEng student is expected to take 8 technical courses + 2 management/business courses taught by the business school.*

I honestly have not observed significant difference between MS and MEng candidates/employees who I have worked with on the technical skill front. However, I do see MEng background employees seem to have slightly better soft skill sets.

- *Do you see any difference between the regular Duke program and this DKU/Duke program? Would you prefer to recruit students from one program over the other?*

DKU seems to have geographic advantage over regular Duke program. If I have operations in Great China region, then I would prefer this special DKU program, because those candidates would have real world experiences via summer internship with all other measurements being equal.

- *Do you value the studying/working experience in China? As an international company, do you see any advantage for your employees to be trained by US university with working experience in China?*

Tough question. Most of US companies' operations in China focus on manufacturing and only few of them put resources on R&D and software development. It's very different from operations in US which focus on sales, marketing, R&D, software/solution development, and product designs. With the digital transformation and cloud computing become mainstream, US companies less care where you work, but more care whether you understand the core business and have necessary skill sets and communication skills. If I don't have operations in China, an US university trained student with China industry experience won't have absolute advantage.

Research Scientist, Facebook, CA, USA

- *Who is your employer and what is your job title?*

Facebook Inc. Research Scientist

- *Do you see any difference between MS (Master of Science) students and MEng (Master of Engineering) students? If you need to recruit a new employee, do you strongly prefer one category over the other? An MS student is expected to take 10 technical courses, while an MEng student is expected to take 8 technical courses + 2 management/business courses taught by the business school.*

Yes, for Facebook, we care most in students' coding and CS analytic skills which is more from MS training than from ME. MS will have higher priority than ME though hiring decisions are mainly based on the interview performance.

- *Do you see any difference between the regular Duke program and this DKU/Duke program? Would you prefer to recruit students from one program over the other?*

Depend on the quality of students graduated from DKU. It usually takes time to build up

reputation of a new program. If the first batch of graduates do well in the company, we will be more than happy to hire more from DKU.

- *Do you value the studying/working experience in China? As an international company, do you see any advantage for your employees to be trained by US university with working experience in China?*

If the new hire eventually works at our US office, it is not an advantage of the candidates compared to other students who study in US.

Principal Engineer, Intel, OR, USA

- *Who is your employer and what is your job title?*

  Intel, Principal Engineer

- *Do you see any difference between MS (Master of Science) students and MEng (Master of Engineering) students? If you need to recruit a new employee, do you strongly prefer one category over the other? An MS student is expected to take 10 technical courses, while an MEng student is expected to take 8 technical courses + 2 management/business courses taught by the business school.*

Depending on the job role, I would pick one or the other. Core R&D type position would need MS but technical project management kind of roles may benefit from MEng.

- *Do you see any difference between the regular Duke program and this DKU/Duke program? Would you prefer to recruit students from one program over the other?*

As long as the final degree says Duke and the student can get work authorization and can clear the interview.

- *Do you value the studying/working experience in China? As an international company, do you see any advantage for your employees to be trained by US university with working experience in China?*

Diverse backgrounds and work experiences are always valuable to me.

9.8. Responses to Master's Advisory Council

The Master's Advisory Council (MAC) has reviewed the proposal for the proposed ECE MEng program. We appreciate the great efforts and insightful suggestions made by MAC. In what follows, we summarize our responses to the questions and comments raised by MAC.

It is clear that considerable time and effort were put into preparing this proposal and addressing historical concerns about programs at DKU. From our discussion it is also clear that there is some confusion on how programs at DKU relate to the programs in Durham and the oversight of Duke University degrees offered through DKU. This is also some confusion over faculty appointment and expectations at DKU. These discussions were not specific to this proposal but suggest additional awareness about the relationship between Duke-Durham and DKU are required.

As indicated by MAC, the questions are not specific to the proposed ECE MEng program. To clarify the connection between the proposed program and the existing program at Duke ECE, Section 3.3 explains how Duke and DKU could collaborate with each other to grow the ECE master programs at both Duke and DKU. We anticipate that the engagement with DKU will add the global component to the current infrastructure of student recruitment and training, resource sharing, technology transfer, etc. at the ECE Department at Duke, eventually helping Duke to establish its international leadership in the global community.

To clarify the degree offered at DKU, Section 3.1 highlights the Duke degree as a unique feature of the proposed ECE MEng program. The degree issued for the proposed program will be identical to that for the existing ECE MEng program at Duke Pratt. The transcript for the courses taught at DKU will list different course numbers. For instance, ECE 551 (Programming, Data Structures, and Algorithms in C++) will be listed as ECE 551K at DKU. All other DKU graduate programs currently follow the same setup.

To clarify the faculty appointment and expectations at DKU, Section 7.2 is added to explain the procedures and policies for faculty appointment, promotion and tenure at DKU. Note that Duke faculty members will be involved in the process in order to assure high standard for faculty development. Tenure appointments will be granted at DKU (not at Duke).

There was also considerable discussion regarding the overall growth of master's programs. The primary concerns were the effect on student services, especially those offered university wide and the risk on the quality of education for all students. Concerns were expressed in a number of areas, including research librarians, student housing, and centralized Student Affairs. The addition of the 100 students in this proposal is not catastrophic, but the cumulative growth of students is a cause for concern as the university-wide services have not kept pace with student growth. One of the challenges with master's growth is that individual schools and programs can add students and there is not a process to plan for additional students or constrain enrollment if university services have reached capacity. There was also discussion of central resource allocation. The proposal has plans for

additional staff to support additional students within the program, but there is not a corresponding plan to increase university support for these students. The assumption has always been that since units are paying allocated costs on the additional expenses enabled by an increase in master's students that the university resources will be increased appropriately. It does not appear that this trickle-down model has been affectively keeping pace with increased enrollment.

The general consensus is that the Provost needs to become more involved in total campus enrollment and resources. For example, each unit should submit a 5 year enrollment plan that can be used to plan and allocate resources and units should be held accountable for their 5 year plans.

We recognize that the proposed ECE MEng program, along with other masters programs at Duke that are growing their enrollments, can require additional resources such as library support personnel. This growth in required library resources is clearly a demand on the university that is beyond our own particular program, but is one in which our program can help to share allocated costs to meet this growing need. With the increase in the number enrolled students comes an increase in the allocated costs to help defray such demand, and we would gladly share in a fractional contribution to the increased supported required based on our own program's demonstrated demand. The aforementioned discussions are added to Section 6.3.

The most significant question is whether or not the program will achieve its stated enrollment goals. The Nielson marketing study provides some good information; however, historically, students in ECE have preferred a MS degree to a MEng degree and it is not clear that the new degree pathway will alter this preference since the financial benefits to pursuing the MEng in ECE at DKU are slightly, but not significantly, lower than pursuing the entire program in Durham.

Most Chinese students at Duke ECE currently prefer to take the MS program over the MEng program, because MEng programs are not popular in China today. However, we want to propose an MEng program, instead of an MS program, at DKU, because the Chinese Ministry of Education (MOE) is gradually converting MS programs to MEng programs in Chinese Universities now. In P. R. China, MS students are required to work on research projects. The Chinese MOE plans to remove the research component from master programs, downsize the MS programs, and only requires PhD students to work on academic research. Given this recent trend in China, we expect that an MEng program will become more competitive than an MS program in China in the near future. The aforementioned discussions are added to Section 4.2.

It is also unclear if these students do come, will it be incremental enrollment or will it cannibalize existing Duke-Durham enrollment? At this point, it seems impossible to predict what the enrollment will be. It is great that the proposal understood this risk and has plans already in place if enrollment does not meet the stated goals.

Instead of competing with the existing master program at Duke ECE, DKU would like to

collaborate with Duke to benefit both Duke and DKU. For instance, Pratt plans to recruit future students from diversified groups with different technical background, career goals, etc. As shown by the market survey in Section 4, most of our DKU MEng students are expected to be Chinese and they plan to return China eventually, while most students in the existing ECE master program want to stay in the US in long term. It is acknowledged that this cohort of students will be predominantly from China and therefore will expand the representation of Chinese in the student body within ECE at Pratt, but we also note that this demographic segment will primarily affect the diversity of the second year of students, with the diversity of the first-year students at Pratt largely unchanged. However, we see this program in collaboration with DKU as an opportunity to reach a segment of potential students (those desiring to return in long term for employment in China) that would not have been previously reached. The aforementioned discussions can be found in Section 3.3.

Duke and DKU will also collaborate to create a variety of channels for student recruitment. Since 2017, a group of ECE faculty members visited several major Chinese cities to host information sessions and a number of WeChat groups were created to advertise the master program for Duke ECE. These activities have helped Duke ECE to attract a large number of high-quality students this year. With the close collaboration between Duke and DKU, we expect to create more efficient and successful recruitment channels in China, thereby helping both Duke and DKU to access high-quality master students. The aforementioned discussions are added to Section 5.5.

The finances for the program seem appropriate and thorough. It was great to see a worst case scenario analysis for half the enrollment where staff hires were reduced if student enrollment does not meet objectives.

Thanks a lot for comments.

The program mentions that 10-20% of the courses these students will take will likely be in Math, CS and Stats. Once the program reaches 100 students, this represents 60-120 class seats annually from departments outside of Pratt. With this significant number of class seats outside of Pratt, there needs to be agreements in place and letters of support provided by Math, CS, and Stats to ensure there is not a significant burden placed on them and that these units are appropriately compensated for this teaching load.

The master students at Duke ECE typically take about 10~20% courses from other departments, including Computer Science, Statistics, Mathematics, etc. As the number of students grows for the proposed MEng program, we plan to coordinate with these departments to discuss possible solutions to address the increased teaching demands so that they are not overloaded by our ECE students. In particular, the following three courses are most popular for ECE master students: Probabilistic Machine Learning (STA 561), Introduction to Algorithms (CS 531) and Computer Networks and Distributed Systems (CS 514). Among these three courses, Probabilistic Machine Learning is taught by Prof. Cynthia Rudin who is a faculty member in

both Computer Science (50%) and Electrical and Computer Engineering (50%). The aforementioned discussions are added to Section 2.5. We are currently talking to the chairs of Math, CS and Stats to get their support letters.

The program envisions students pursuing 4 different academic tracks. Historically, most students in ECE focus on the Computer Engineering track. It seems like a significant assumption that these students will have different interests than our current master's population. This assumption is critical since faculty will need to be hired to teach in each of these tracks. It seems like additional effort needs to be focused on understanding student interest in each track on before hiring faculty in a track. It may be beneficial to focus on 1-2 tracks initially and hire faculty in additional tracks if there is sufficient student interest. Given that the Durham program expects most students to be in either computer engineering or big data analysis (pp. 21-22 or proposal), it seems like DKU should also focus on these two tracks.

Based on the recent analysis by Prof. Drew Hilton who is the Managing Director of Graduate Studies at Duke ECE, most ECE master students are taking courses in two focused areas: (1) computer engineering (about 50%) and (2) signal processing and communication focusing on big data analysis (about 50%). Following the suggestions from MAC, we will initially focus on CE and SP and offer most courses in these two areas. If our students express strong interests in other areas, we will grow additional concentration areas in the future. The aforementioned discussions are added to Section 2.3.

The proposal is relying on future space additions at both DKU (planned Innovation building at DKU) and Durham (new planned Engineering building scheduled to open Fall 2020). If both of these building are completed on time, there should be sufficient space for this program. If either of these infrastructure projects are delayed, should the launch of the program be delayed? Additionally, with the undergraduate program starting at DKU, there needs to be more detailed plans for the housing and academic space uses at DKU.

The Innovation Building is expected to be ready for use at DKU in Spring 2019. When the first batch of our students arrives in Fall 2019, the Innovation Building should be available. The Innovation Building is also required to host additional undergraduate students who will join DKU in Fall 2019. In case the Innovation Building is not ready, the contingency plan is for DKU to rent off-campus space for labs, offices, etc. The aforementioned discussions are added to Section 5.3.

At DKU, our master students are expected to live in off-campus apartments. Instead of asking each student to find his/her own apartment, DKU will rent a few apartment buildings so that all students could live together. DKU has already been exploring several possible candidates such as Fortune Plaza that is about 1.5 miles away from campus. These discussions are added to Section 6.3.

At Duke, in case the new engineering building is delayed, only one classroom is needed for Fall 2020 and Spring 2021 to host 25 students and we will work with Pratt and ECE to find an

available classroom or large conference room on campus. These clarifications are added to Section 5.4

The TA support numbers shown in Table 13 seem high. It assumes 4 TA's per class. Is this correct? Also, there is no change in the number of TA's when going from 100 to 200 students for the 2025/2026 year. In Table, 13, there is not an increase to 200 students. Is there a typographical error?

Depending on the course load, we need 2~4 PhD TAs per session. Note that 4 PhD TAs are required for a course with heavy course projects (e.g., ECE 550). Hence, 30 PhD TAs are needed to serve these 10 sessions. The number of students in Table 13 should be 100, instead of 200. It was a typo. Table 13 is now updated with the correct numbers.

For Duke University programs offered at DKU, how are the faculty selected? Is there input from the Duke-Durham counterparts? Input into the hiring of adjunct was mentioned, but a not a process mentioned for full time faculty. The proposal should clearly outline the process for hiring new faculty and the involvement of the Duke-Durham ECE faculty in this process. Also, once DKU faculty are hired, how are these faculty reviewed and assessed? How will Duke-Durham ECE faculty participate in this process?

Section 7.2 (Faculty Appointment, Promotion and Tenure) has been added to clarify these issues. Procedures about faculty appointment, promotion and tenure at DKU are outlined in the policy of "Academic Tenure and Faculty Appointment, Promotion and Tenure" approved by the DKU faculty and board. Details specific to our program include a search committee composed of two Duke ECE faculty members and the Program Director, who will review all application materials. Selected faculty candidates will be interviewed at the ECE department at Duke. After the interview, the search committee will collect feedback and then nominate successful candidates to the DKU Faculty Appointment Committee, which includes 9 faculty members in total (5 from Duke, 2 from DKU and 2 from Wuhan University). This committee then makes recommendation to the Executive Vice Chancellor for appointment. Faculty members might be recruited for tenure-track or non-tenure-track positions. Duke will be fully responsible for faculty requirement at Duke. DKU will not be involved in faculty recruitment at Duke.

Each faculty member will be reviewed annually at DKU. The pre-tenure period is seven years of full-time service. The initial appointment is for a term of four years. Renewal of the initial appointment for a second four-year term will be made on the basis of careful review by a dedicated review committee composed of ECE faculty from both Duke and DKU, favorable recommendation by the DKU Faculty Appointment Committee, and favorable recommendation by the DKU Vice Chancellor for Academic Affairs. All promotions to associate professor with tenure or full professor with tenure shall be considered by a dedicated review committee with ECE faculty from both Duke and DKU, the APT committee composed of 9 faculty members in total (5 from Duke, 2 from DKU and 2 from Wuhan University), and the DKU Vice Chancellor for Academic Affairs. The three primary criteria for tenure evaluation are quality of (1) teaching,

(2) research and/or other scholarly activities and (3) service to the university. Tenure appointments will be granted at DKU (not at Duke).

The proposal only briefly mentions anticipated student quality. There needs to be more discussion of student quality and criteria for admission. It is great that in section 7.3, the expectations are that the GPA/GRE scores of the DKU students should be comparable to the Duke-Durham students. The historical student scores should be provided in the proposal for reference.

Similar to the master program at Duke ECE, a successful applicant to our proposed ECE MEng program at DKU are expected to hold an undergraduate degree in sciences or engineering. The admission decision will be made based on several factors, including letters of recommendation, undergraduate coursework/preparation, undergraduate GPA, GRE score, etc. The quality of students admitted to the proposed ECE MEng program, measured by their GPA, GRE scores, etc., should be comparable to that of the existing ECE MS/MEng program at Duke. Table 15 summarizes the average GRE and GPA for admitted MS/MEng students at Duke ECE. These discussions are added to Section 6.1.

9.9. Responses to Global Priorities Committee

The Global Priorities Committee (GPC) has reviewed the proposal for the proposed ECE MEng program. We appreciate the great efforts and insightful suggestions made by GPC. In what follows, we summarize our responses to the questions and comments raised by GPC.

The committee would encourage better clarity in the language that is used to describe the relationship between DKU and Pratt in running the ECE program – i.e., pertaining to "ownership" of the program – given that this is a Duke degree and must meet SACS accreditation.

Clarifying language has been added to indicate that the proposed program is an MEng program at DKU that will be jointly managed by both Duke and DKU, with faculty at Pratt ensuring that the program is of the high quality required for a Duke degree. The program will be targeted especially to students who desire an educational experience in both China and the U.S. The aforementioned statement has been added to the first paragraph of the Executive Summary.

Much of the discussion focused on how to better characterize the program in the executive summary so as best to capture the extent to which the program is truly global and diverse. Committee members noted that because of the China internship experience, the program is designed to primarily target PRC students.

Students are free to choose their preferred locations for summer internship. We expect that most Chinese students will complete their summer internship in China and most international students may pursue the summer internship in their home countries. The aforementioned clarification has been added to Section 2.2 and 2.3.

The committee asked how this will impact non-Chinese students, especially in the ECE program at Duke, given that their presence on campus for the second year will further reduce the diversity of that program as well. This is the first of the five master's programs that is clearly not intended to be international.

Most of our MEng students are expected to be Chinese and they plan to return China eventually, while most students in the existing ECE master program want to stay in the US in long term. Our proposed MEng program will therefore help attract a different group of students than that in the existing masters program at Duke. It is acknowledged that this cohort of students will be predominantly from China and therefore will expand the representation of Chinese in the student body within ECE at Pratt, but we also note that this demographic segment will primarily affect the diversity of the second year of students, with the diversity of the first-year students at Pratt largely unchanged. However, we see this program in collaboration with DKU as an opportunity to reach a segment of potential students (those desiring to return long-term for employment in China) that would not have been previously reached. The aforementioned clarification has been added to Section 3.3.

If the student body will not be diverse, perhaps there are other ways the program can build diversity through faculty hiring, and symposiums that might attract people from around the world. The committee noted that the potential gender diversity of this program is another type of diversity that could make this program interesting. There could be a concerted effort to hire women faculty. The committee would like to see clearer evidence of the suggested interest from women students. The committee felt more attention could be paid to examining how to broaden the international student body and to consider how the internship experience could attract more international students. Another potential avenue of increasing diversity may be to target financial aid at students applying from elsewhere.

We fully agree with the committee that diversity is an important consideration, and in view of the likely large representation of students from China, there might be other areas of diversity to highlight. One such potential focus for diversity is in gender balance, since women have historically been underrepresented in engineering. We are strongly committed to advancing gender equity in our faculty and student body, and as an example, we have been actively recruiting a female faculty member, Prof. Mei Chen, from The State University of New York at Albany. Prof. Chen received her PhD from Carnegie Mellon University in 1999 and is an internationally renowned expert in computer vision. She has extensive experience with major industrial companies including Intel, HP and SRI and is now an associate professor at The State University of New York. Taking Prof. Chen as an example, we will make all efforts to recruit female and minority faculty members to build the diversity for our proposed ECE MEng program. The aforementioned statement has been added to Section 2.5.

The market survey data indicates that female students have shown strong interest in the proposed ECE MEng program. During student recruitment, we want to identify those factors that will be significant in attracting female students, in order to build a diversified ECE MEng program. The aforementioned clarification has been added to Section 4.1.

When recruiting students, we will actively encourage female and minority students to apply to our program. During our recruitment events, we will host special sessions for these students. In addition, we will closely work with the faculty members and academic researchers in other universities and encourage their female and minority students to apply. As the undergraduate program at DKU grows, we will further encourage our own undergraduate students to apply to ensure diversity. The aforementioned statement has been added to Section 5.5.

We will consider diversity as an important metric when distributing financial aid. Female, minority and international students will be considered with high priority for financial support in order to attract them and, consequently, increase the diversity of the proposed ECE MEng program. The aforementioned clarification has been added to Section 5.1.

The committee inquired about the implications for DKU faculty, since DKU can't hire that many faculty for just one program. The committee was also concerned about whether the faculty will have tenure, and at which institution. The committee raised the point that half-time DKU appointments will be more important than whole appointments so that the students

will not be taking a high proportion of classes from the same faculty.

To offer diversified courses, we plan to share teaching resources with the undergraduate program at DKU. Our faculty members from the proposed ECE MEng program are expected to teach the undergraduate students (e.g., for the data science major) at DKU. In this way, we will be able to recruit more than 4.5 faculty members over a broad range of technical areas with 4.5 FTEs. The aforementioned clarification has been added to Section 2.5.

To clarify the faculty appointment, promotion and tenure at DKU, Section 7.2 is added to explain the procedures and policies for faculty appointment, promotion and tenure at DKU. Note that Duke faculty members will be involved in the process in order to assure high standard for faculty development. Tenure appointments will be granted at DKU (not at Duke).

The presentation suggested that most Pratt students are able to afford the full ECE tuition, especially because of their job prospects after graduation. The same is anticipated with regard to Chinese students. Thus, it would be good to further distinguish why students from China would opt for the Kunshan program over the Durham program.

As shown by the market survey in Section 4, most of the MEng students targeted for the DKU program plan to return to China eventually, while most students in the existing ECE masters program want to stay in the US in long term. This implies that our proposed MEng program will help to attract a different group of students who have not been recruited by the existing masters program at Duke. The aforementioned discussions can be found in Section 3.3.

Lastly, concerns were also raised about the way in which the program and overall growth in Pratt's Master's student population put significant strains on University-wide resources such as library services. The Duke University Libraries (DUL) have only one librarian to provide research assistance and library instruction for all of Pratt and Computer Science, and past experience indicates that students in Duke's current MEng program require more intensive library support than do undergraduate and doctoral students in Pratt. Likewise, demand for workshops and consultations from DUL's Data and Visualization Services, heavily used by Pratt students, already exceeds the capacity of existing staff.

We recognize that the proposed ECE MEng program, along with other masters programs at Duke that are growing their enrollments, can require additional resources such as library support personnel. This growth in required library resources is clearly a demand on the university that is beyond our own particular program, but is one in which our program can help to share allocated costs to meet this growing need. With the increase in the number enrolled students comes an increase in the allocated costs to help defray such demand, and we would gladly share in a fractional contribution to the increased supported required based on our own program's demonstrated demand. The aforementioned discussions are added to Section 6.3.