An Effective Industry-University Partnership to Develop Tomorrow's Workforce

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He was also nominated for 2004 UNI Book and Supply Outstanding Teaching Award, March 2004, and nominated for 2006, and 2007 Russ Nielson Service Awards, UNI. Dr. Pecen is an Engineering Technology Editor of American Journal of Undergraduate Research (AJUR). He has been serving as a reviewer on the IEEE Transactions on Electronics Packaging Manufacturing since 2001. Dr. Pecen has served on ASEE Engineering Technology Division (ETD) in Annual ASEE Conferences as a reviewer, session moderator, and co-moderator since 2002. He served as a Chair-Elect on ASEE ECC Division in 2011. He also served as a program chair on ASEE ECCD in 2010. He is also serving on advisory boards of International Sustainable World Project Olympiad (isweep.org) and International Hydrogen Energy Congress. Dr. Pecen received a certificate of appreciation from IEEE Power Electronics Society in recognition of valuable contributions to the Solar Splash as 2011 and 2012 Event Coordinator. Dr. Pecen was formerly a board member of Iowa Alliance for Wind Innovation and Novel Development (www.iawind.org/board.php) and also represented UNI at Iowa Wind Energy Association (IWEA). Dr. Pecen taught Building Operator Certificate (BOC) classes for the Midwest Energy Efficiency Alliance (MEEA) since 2007 at Iowa, Kansas, Michigan, Illinois, Minnesota, and Missouri as well as the SPEER in Texas and Oklahoma to promote energy efficiency in industrial and commercial environments.

Dr. Pecen was recognized by State of Iowa Senate on June 22, 2012 for his excellent service and contribution to state of Iowa for development of clean and renewable energy and promoting diversity and international education since 1998.

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Abstract

This paper presents Sam Houston State University and Quanta Service Workforce Development (QSWD) Program as a significant initiative to bring together higher-education and the business world for a symbiotic workforce development relationship. Through this partnership, Sam Houston State University is able to enhance its Engineering Technology (ETEC) program with guidance, feedback and interaction from a highly technical and industry leading organization, Quanta Services (QS), the largest specialty contractor in North America that provides Engineering, Procurement and Construction (EPC) services for comprehensive infrastructure solutions to the electric power, telecommunications and oil-gas industries. In turn, through the partnership, Quanta Services provides an easy access to the qualified candidates for available positions upon their graduation from Sam Houston State University. As part of the partnership, a Quanta Endowed Professor position was also established and a new faculty member was hired by the funding provided initially by Quanta Services to serve in conjunction with a Quanta Services designated representative to lead the key partnership programs. The focus of all programs are based on the goal of increasing within graduating students, job specific skills and improved industry awareness, which will make the students better suited to fill the present workforce gap more quickly upon hire. The pilot program was focused in three main areas: slightly enhanced courses from the engineering technology curriculum, a company and industry specific minimester course and an internship program. The paper also describes a unique industry-university partnership example that includes industry-site course offerings to develop job specific skills that expand to the project management level workforce. In an industry centric and company specialized minimester course, the students stay at a state-of-the-art, remote industrial training site and receive classroom and practical application training on full life-cycle utilities project management with the help of company experts from Quanta Services.

Introduction

As the technology innovates quickly, a pro-active industry-university partnership has constituted a backbone to an effective future workforce development including engineers, engineering technologist and technicians who can adopt the technological innovations promptly and effectively in the industrial environments. As the highly-skilled and experienced technical employee from the baby-boomers generation begin to retire in vast amounts, stable and quick replacement of management and technical workforce with the qualified employee has been a challenging problem to solve [1]. Although the topic of the university-industry collaboration was discussed in the vast majority of the literature in various areas; due to very fast pace of the technological innovations and services in the industry, corresponding collaboration efforts with the academia will continue to be subject of new educational research efforts [2-5]. An industry-university partnership has many fruitful outcomes; (1) industrial personnel may have an opportunity to become a pro-active member in a specific academic program and departmental industrial advisory boards, (2) the company may provide internships and part-time job opportunities to the qualified students and establishes scholarship programs to honor the

company and the university, (3) allows students to develop their senior design/capstone projects in the industrial environments, (4) opens an effective way of reaching academic programs and students by expert-speaking opportunities, (5) provides part-time and honorary teaching opportunities that positively impact both student team members and the company's project development efforts, and finally (6) the partnership may help academic departments to easily access corporate equipment grants or use the company's equipment surplus programs.

Department of Engineering Technology (ETEC) at Sam Houston State University has signed an executive endowment agreement with QS that has already started to establish a fruitful business relationship and implement a workforce development program between two entities beginning Fall 2016 semester. The university's recent strong partnership with this major Engineering Procurement Construction (EPC) Company also makes telecommunications, oil & gas pipeline, electrical power transmission and renewable energy curriculum central to the University and College's strategic planning that will produce future engineering technology graduates who are ready for implementing conventional and renewable energy technologies and applications on their areas of concentrations. This strategic partnership targets to support current and future academic program developments, enhances curriculum based on company's needs and finally establishes a pro-active relationship to prepare Sam Houston State University students for the future workforce needs.

Industrial Partnership Program Objectives

QS-Sam Houston State University Partnership is a workforce development program initiative to bring together higher-education and the business world for a symbiotic workforce development relationship. The intended goal of the program is to help SHSU students develop job-specific skills and improve industry awareness in order to better meet the rapidly evolving workforce needs. Quanta Services identified a middle management workforce gap in their industry (utilities infrastructure EPC), and through the partnership, are seeking to fill that gap by "training" students to enter the industry with a well-rounded and job-ready skill-set. The pilot program was focused in three main areas: slightly enhanced courses from the engineering technology curriculum, an industry centric and company specific minimester course and an internship program. Beginning in the spring semester of 2017, the partnership began the pilot program that had participating students gain exposure to QS through the enhanced courses, intensive minimester course, and as paid interns with one of several participating QS operating units (QS is a holding company that has several wholly owned subsidiaries referred to as Operating Units or OpU's). In turn, through the partnership, Quanta provides easier access to the qualified candidates upon their graduation from Sam Houston State University. The partnership efforts were originally lead by an external consulting company called Alvarez & Marsal (A&M) who was hired by QS to create the workforce development program between the University and QS. Once the pilot program was designed and implemented, QS transferred the program to an in-house team to continuously improve and lead the program into the future.

Course Enhancements

The QS identified opportunities within the ETEC curriculum and worked closely with the faculty to introduce Quanta and industry-relevant up-to-date information into the coursework of

different classes as listed on Table 1. ETEC faculty, the A&M and QS consultants have spent major time to discuss potential changes on the identified courses to align with industry needs as well as appropriate with the University's regional and future ABET-ETAC accreditation efforts. In this process ETEC faculty members have had a chance to work with the specific QS representatives to identify the technical competencies that the industry requires for potential employment [5-8]. A number of face-to-face and conference call meetings were held with individual course instructors. All the course details, targeted competencies, and the current status are listed in Appendix A and B.

Table 1. Recommended ETEC classes to be completed prior to the Internship Program

ETEE 1340 Intro. to Circuits	ETEE 2320 Circuits and Systems
ETEC 1100 Engineering Foundations	ETSM 4363 Safety Program Management
ETCM 4368 Building Materials	ETEC 4380 Material Handling & Plant Layout
ETEC 4382 Industrial Safety	ETEC 3340 Solar & Wind Energy Systems
ETCM 4330 Const. Management & Pro.	ETEC 4340 Alternative Energy Technology
ETEC 4384 Supervisory Personnel Pract.	

Minimester Course Development and Internship Program

The minimester and the Internship Program expose QS to potential new hires and allow Sam Houston State University students to obtain both Quanta and industry experience.

Minimester Course

The ETEC 4369 Utilities Project Management (UPM) minimester course starts right after final exams completed, on Sunday evening at the QSC's state-of-the art, 2100 acres training center, The Lazy Q Ranch (LQR) located in La Grange, Texas. The students in the program spend an immersion week at the LQR, Quanta's world class training facility lead by mentors from 5 participating QS OpU's. Students work as teams to complete a project and address challenges from Quanta's own extensive project archives under the guidance of QS Project Management experts. The Utilities Project Management minimester provides a high impact learning experience for SHSU students and enables students to engage with and learn from some of the industry's top experts at Quanta's Lazy Q Ranch (LQR) training facility. The course focuses on the elements of the EPC project management lifecycle using real projects from Quanta's Operating Units that were put into a standard format and centered on the Lazy Q Ranch facilities and equipment. The projects used as case studies in the course, span the industries Quanta serves, giving students a good blend of exposure to EPC projects in the Electric Power, Oil & Gas pipeline and Telecommunications industries. A total number of 16 students (junior/senior standing) participated in the pilot UPM minimester course in summer 2017 semester and there will be about a maximum of 25 students expected for the updated class in May 2018. Students were evaluated by the course instructors before student registration to take the course. The purpose of the initial evaluation was to make sure students understand the importance and objectives of the course and spending five days at Laz-Q-Ranch facility. After spending five days at the training facility, students completed all the course related instruction at the university campus the following week. The course assessments and instructions were shared among SHSU

course instructor and Quanta mentors. Some of the course details are summarized on Table 2 below. Summer 2018 course format and highlights will be similar to Table 2 with the addition of two new QS OpU's participating, Quanta Telecom Services, and MG Dyess Company.

Table 2. Minimester course format and highlights (Summer I, 2017)

Course Format	**Course Highlights**

• Classroom instruction
• Hands-on and LQR activities
• Team case project based on real QS projects
• Quanta project mentorship
• Daily assignments and final exam
	• Co-led by a XYSU Professor and three Quanta Operating Unit Mentors from Dashiell, NHPL, and QPSE
	• Students had the privilege to meet with the following leaders from Quanta:
	  • Duke Austin, President (CEO & COO),
	  • Derrick Jensen (CFO),
	  • BJ Ducey (Senior VP Operations),
	  • Wilson Yancey (VP Safety)

The minimester class in May 2017 was a great success at the LQR training facility. A similar program is now planned for minimester 2018 in May 13-18, 2018. Figure 1 and Figure 2 exhibit student activities and training at the Quanta's LQR facility.

Figure 1. Minimester class offered at Quanta's Lazy Q Ranch 9LQR) Training Facility.

Figure 2. Student activities at minimester class offered at Quanta's LQR Training Facility.

Internship Program

The Utility Industry Intern's job responsibilities are described as follows: under an immediate direction and guidance of a Project Manager, the intern may to assist various stages of a project's lifecycle; initiation, planning, execution, monitoring and controlling, closing, and servicing of a utilities construction project. The internship assignments are with one of the regional participating Quanta OpU's in one of the following industry segments; electric power, telecommunications, or oil & gas, and may contain an environmental component. The minimum qualifications require internship applicants to be full-time students enrolled in the ETEC program with completion of sophomore year. The eligible students must also demonstrate basic oral and written communication skills, have familiarity with MS Office tools, be willing to travel to job sites in the state, be a self-starter with the ability to manage his/her time and resources, show strong interpersonal skills, have the ability to be flexible and maintain a positive attitude, and finally be a person of determination and trustworthiness. Preferred qualifications include bilingual abilities due to the very diverse work environments QS works in, have a general understanding of budgeting, other basic business management concepts, and the completion of the previous ETEC classes listed on Table 1.

The Utilities Industry Internship began in the summer of 2017 and placed the interns directly under Houston-area project managers. Quanta's Operating Units, Dashiell, Mears Group, North Houston Pole Line and QPSE were the hosts of the pilot program. It is an eleven-week paid internship that earns the candidates three-to-six credit hours. The Internship Program exposes Quanta to potential new hires and talent, and provides interns with valuable Quanta-related experience and industry knowledge, resulting in an experienced and well-trained talent pool of candidates for Quanta and its Operating Units to hire for full-time positions. The Summer 2017 Internship Program (ETEC 4390 Work Base Mentorship) spanned 11 weeks and placed 8 interns across 4 different Operating Units, filling roles in project management, procurement, safety, and quality. Some of the findings are summarized on Table 3. The program is growing in 2018 with an expected 14-16 interns across 7 Quanta OpU's planned for the summer.

Sam Houston State University ETEC students qualified for paid QS Internship are placed at one of the following Quanta operating units:

i. Dashiell is a leading national provider of technical services to the electric utility, power generation, industrial, renewable, and energy industries.

ii. North Houston Pole Line is one of the largest construction contractors in the Southwest, providing a wide array of services in many rural, urban, and geographical areas.

iii. Mears Group is a full service engineering and construction firm offering an extensive catalog of services to the oil, electrical power and water industries.

iv. Price Gregory is a leading provider of infrastructure services with focus on pipeline construction and related services.

v. T.G. Mercer is an expert in pipe unloading, pipe handling and pipeline logistics for the oil and gas pipeline construction industry.

vi. Quanta Telecom Services offer construction management, construction of underground structures, inspection services related construction of underground structures and all services necessary for the complete installation, maintenance and repair of underground structures, as part of its Q-Trench Solution brand of services.

vii. QPSE provides project management, engineering, procurement, environmental and construction services – in partnership with other Quanta Services companies for pipeline ad associated oil and gas production facilities.

Table 3. Summer 2017 Internship Program Facts

Standing	Majors Include	Statistics
• 4 Seniors • 3 Juniors • 1 Sophomore	• Construction Management • Electronics & Computer Engineering Technology • Design & Development • Safety Management	• 33 ET students applied for Internship Program • 24 students participated in Round 1 Interviews • 14 students participated in Round 2 Interviews • 9 students received Internship offer • 8 students participated in pilot Internship Program • 5 students received either Full-Time or Extended/ Repeat Internship offer

Figure 3 exhibits the functional block diagram of QSC's Internship Program flow from an initial student application to a final internship offer process. Feedback from QS personnel who observed the students' progress during the internship, help Quanta OpU leadership to determine if the student will be asked for a repeat internship or full-time offer of employment.

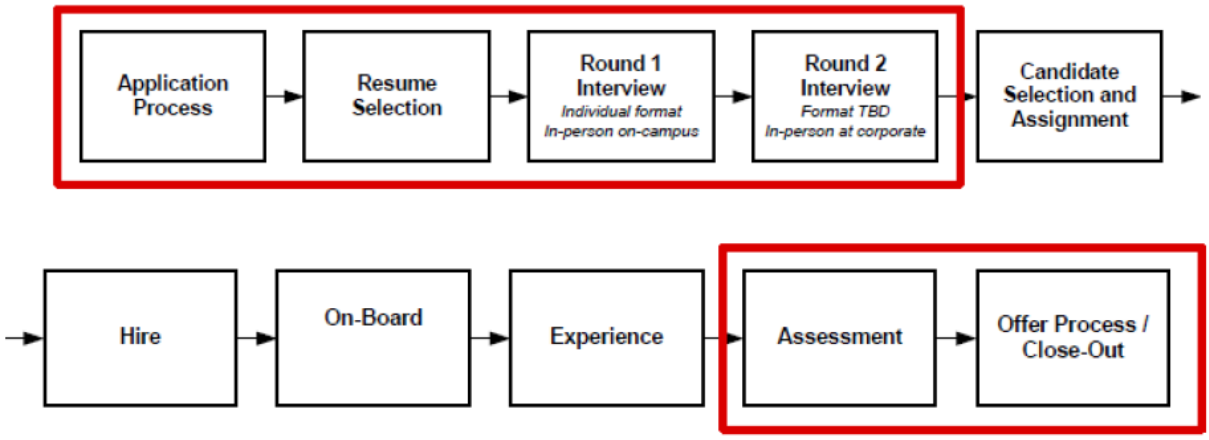

Figure 3. Internship Program flow with Quanta Services [7]

The QSC representatives have been diligently visiting the university campus and collaborating with the faculty and administration to advertise and recruit the most qualified students for the partnership. A number of on-campus events are listed on Table 4 as follows.

Partnership Program Assessments

Program assessment data using surveys and one-to-one interviews from university faculty members, students, Quanta expert instructors, and the LQR training facility program organizers were collected and analysed. A Quanta-University benchmarking study that includes the

following three gap themes was completed that provided high potential opportunities and recommendations for continuous improvement of the brand-new ETEC program at the Sam Houston State University.

Table 4. On-Campus Events

ACTIVITY	NOTES
Career Day on Campus	Career Fair targeting ET students; Quanta employees to present on company; QSWD Team to encourage students to apply for Internship Program / minimester course
ETEC 1100 Department Speaker	Quanta speakers on Campus for ETEC 1100 Dept. Speaking Engagement for both fall and Spring semesters
Internship Program Info Session	Meet with students to answer questions / encourage to apply for program Fall and Spring semesters
Quanta-University Partnership Info Session	Info session on Campus; Spring semester, Quanta speakers, representatives from QSWD Program to speak / get to know students / answer questions
Round 1 Interviews	Round 1 Interviews @ campus for Summer Internship
Round 2 Interviews	Round 2 Interviews @ Quanta Corporate
Semester Kick-off Meeting w/ Faculty members	Meeting with faculty members to kick off all program-related events for the semester
Agricultural Sciences & Engineering Technology Career Fair	Participate in the SHSU Agricultural Sciences & Engineering Technology Career Fair in the Spring Semester

The benchmarking recommendations include three gap themes; (1) Industry focus, (2) leadership/Management Focus, and (3) Professional development opportunities. Therefore Quanta-sponsored special programs need to be designed as follows:

i. Team competition based on real Quanta OpU project
ii. Supplemental year-long capstone-design (senior design) projects
iii. Student organization focused on utilities/industrial construction project management

The value-added course additions include; increase specialized project management courses, introducing industry course focused on teaching power generation (a new electrical power systems and machinery course proposal was submitted recently), and requirement of additional business courses in accounting, economics, and finance although this recommendation may bring serious challenges of extended program requirements of more than 124 credit hours which is not welcome by both the University administration and the Texas Higher Education Coordinating Board (THECB). The major outcomes of the Quanta-University partnership can be listed as; (1) graduating qualified ETEC students and highly desired future work force employee, (2) funding support for course and lab development, (3) Quanta technical managers talks at the University, (4) internship information sessions with pizza and refreshments for students, (5) establishing an Endowed-Professor position by the company (one was already hired and one to be hired next academic year), and the finally (6) very positive student and faculty morale for being an up-to-date ETEC department that is strongly supported by a Fortune 500 company.

Conclusions

As mentioned in the earlier literature by Prof. Frank Hughes "*Universities need to start listening to their customers as well as listening to and understanding the criticisms of academia and the basis for these criticisms. Universities should not make rules or decisions or decide how to respond to the various criticisms of academia without getting feedback from their various customers as part of the decision making and rule-making processes*" [9]. This is indeed very significant for the ETEC graduates who will be tomorrow's workforce in quickly innovating industrial environments. SHSU-Quanta Service Workforce Development (QSWD) Program is a unique symbiotic workforce development relationship that brings a public higher education institution and the business world together for win-win benefits. Beginning in the spring of 2017, the partnership provided faculty members to begin offering courses to develop job specific skills that expand the project manager level workforce. These students have mentors and exposure to the largest specialty contractor in North America, Quanta Services. In turn, through the partnership, Quanta provides access to the qualified candidates upon their graduation from Sam Houston State University. A Quanta Endowed Professor position was also established and a new faculty member was hired by the funding provided initially by QS to serve in conjunction with a Quanta Services designated representative to lead the key partnership programs. After 8 paid internship positions in 2017 summer, there are currently 22 paid Quanta Services internships are awarded to the qualified ETEC students in all areas. This program is continuously offering modified courses that are currently a part of the ETEC department, a minimester and an internship program. Operating Unit and Quanta managers were able to advise on what would make a "good candidate for employment" and these 22 areas became a part of the enhanced syllabi. This unique partnership has already started to produce high quality graduates who are being hired by the QS. Based on the student and faculty interest, the program is expected to further grow with continuous improvement efforts.

Acknowledgements

The Quanta Services Company and specifically Mr. Earl C. "Duke" Austin, Jr., President, Chief Executive Officer and Chief Operating Officer are greatly appreciated for the financial and logistic support for this unique partnership program. The external consulting company, Alvarez & Marsal - A&M and their staff members are also appreciated for the initial strategic work with the Sa Houston State University faculty and administration. Quanta Service's wise efforts to enhance the ETEC curriculum to ensure students are as prepared as possible to enter the workforce immediately upon graduation is also greatly appreciated and acknowledged.

Appendix A – Sam Houston State University - Quanta Program: Major Progress to Date

Stage	Courses	Competency	Status/ Deployment
1	**ET Core Courses** • ETEC 1100 – Foundations of Eng. Tech. + Department Speaker • ETEE 1340 – Intro to Circuits • ETEC 4384 – Supervisory Personnel • ETEC 4369 – Lazy-Q Immersion Experience (outline)	• Exposure to Industry • Industry Technology • Transmission & Distribution • Telecommunication • Field Ready • Single and Three-Phase AC Electrical Systems	Complete Fall 2016
2	**Quanta Experiences and Engagements** • ETEC 4369 – Minimester content build	• Utility Industry - Power & Pipeline	Complete All

	• ETEC 4391 – Internship process build • Career Day (Fall) • Club Speaking Engagement – material and logistics **Support of Stage 1 Deployment* **ET Core Courses** • ETSM 4382 – Industrial Safety	• EPC Industry • Power & Pipeline – Engineering, Design, Construction • Construction & Project Management • Accounting & Budgeting • Negotiation & Conflict Manag. • Safety • Telecommunications Fund. and Hands on Projects	Semesters in 2017 Fall 2017 & Spring 2018
3	**Stage 1 and Stage 2 Deployment Support** • ETEC 4369 – Minimester instructor and material preparations and logistics; NHPL + QPSE Case Build; course deployment • ETEC 4391 (Internship) – Internship continued build, deployment support (R1 and R2 interviews, selection, experience) • Career Fair (Spring) – Material & Logistics • Department and Club Speaking Engagement – Material and logistics **Support ET Core Course Deployment*	• Communication • Field Ready • Safety • Telecommunications	Complete All Semesters in 2017 Spring 2018
4	**ET Core Courses** • ETEC 3374 – Time & Motion • ETCM 4380 – Materials Handling **Construction Management Only** • ETCM 4330 – Construction Management Procedures • ETCM 4369 – Surveying **Stage 3 Deployment Support:** • ETEC 4369 – Minimester alterations and adjustments • ETEC 4391 – Internship experience through close out • New Hire Process deployment and support • Career Fair (Spring) – materials and logistics • Department and Club Speaking Engagements, etc.	• Project Controls and Scheduling • Supply Chain • Construction & Project Management • Civil – General • Power & Pipeline – Engineering, Design, Construction • Telecommunication	July 2017 – Fall 2017 Spring 2018

Appendix B – Sam Houston State University Courses

Course	Description	
ETEC 1100 Engineering Foundations	Focus on leadership and study skills necessary for succeeding in the many career options available to professionals in industrial education, business, and industry	Addition of a Quanta speaker each semester, covering the industry, Quanta as a company, and potential career opportunities Sample resumes and job descriptions for student use
ETEE 1340 Intro. to Circuits	Provides fundamental understanding of electronics in AC/DC circuits.; emphasis on knowledge and application of electrical safety, power generation, metering instruments, etc.	Addition of AC content and examples focused on high voltage and electrical power systems Addition of supplemental homework assignment focused on AC content

ETSM 4384 Industrial Safety	Study of the problems involved in developing an integrated safety program for an industrial or commercial establishment	Addition of current and relevant safety-related articles, Quanta safety videos and standard safety practices Addition of quiz and exam questions to test understanding of these concepts
ETEC 4384 Supervisory Personnel	Introduces students to the principles of management pertaining to personnel, management, supervisory information, training, etc.	Addition of multiple case scenarios relating to real-life common supervisory-related challenges and information on how these scenarios should be properly handled
ETEC 3374 Time & Motion	Systematic and practical approaches of motion and time study techniques focused on increasing efficiency in industrial settings	Addition of application, lessons learned, and examples of industry resources related to efficiencies around materials handling processes, procurement, and QA/QC
ETCM 4380 Mat. Handling & Layout	Basic requirements needed to develop the most efficient layouts of equipment and servicing facilities and industrial application	Application, lessons learned, and examples of industry resources related to materials handling processes, procurement, and QA/QC; BOM examples & Project management handout
ETCM 4330 Const. Mgmt. Procedures	Construction application related to site prep, foundation, concrete, wood, and metal construction methods, as well as cost estimation and procedures for bidding	Lecture material related to standard / real-world safety practices, etc. Addition of project documentation as supplemental materials
ETEC 4369 Surveying/Utilities Project Management	Fundamental surveying methods, operations, procedures, and equipment required for a construction site	Addition of surveying company profile to provide overview of potential career opportunities Assignment requiring research on Industrial Construction-related surveying Project examples

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