

Industry-University Partnership Case Study

Charles Baukal¹, Joe Colannino¹, Wes Bussman¹ and John Matsson²
John Zink Co. LLC¹/Oral Roberts University²

Abstract

This paper describes a partnership between an engineering equipment manufacturer and a local private university. The industrial partner provides adjunct instructors to teach several mechanical engineering courses, serves on the industrial engineering advisory board, and supports the university in a number of other ways. The students benefit from being taught by experienced industry engineers who have a passion for teaching. The industry partner benefits from direct exposure to potential hires and providing an outlet for its employees to teach and keep their technical skills sharp.

Introduction

John Zink Company, LLC (JZ) is a world-renowned supplier of industrial combustion equipment, such as burners and flares, to the process industries. JZ has a world class test facility (see Figure 1) used to demonstrate full-scale combustion equipment performance. JZ offers continuing professional development short courses (see Figure 2) related to its technologies to practicing engineers and plant operators through its John Zink Institute (JZI).¹ Oral Roberts University (ORU) is a private Christian institution that offers a wide range of academic programs including engineering. JZ is located approximately 14 miles from ORU, which is about a 20 minute commute by car.



Figure 1. JZ Research and Development Test Center.



Figure 2. Photo of a typical short course taught at the JZI.

The relationship between JZ and ORU was initiated in the spring of 2008. An ORU mechanical engineering professor was going on sabbatical in the fall and a request was made to the members of the local ASME section to look for people interested in teaching several ME courses. One of the authors of this paper, a JZ employee who is an ASME member, responded with interest in teaching one of the courses. This was the start of an ongoing partnership between JZ and ORU which is described in this paper.

This paper discusses some of the many ways that industry and universities can partner together. It then presents a case study of an industry-university partnership that includes industry: teaching engineering courses at a local university, serving on an engineering advisory board, and providing general support to the engineering program.

Examples of Industry-University Partnerships

Industry Adjuncts

One way that industry and universities can collaborate is when industry provides individual instructors to teach existing courses as adjuncts or visiting professors.² McMasters and Komerath (2005) describe a program developed by Boeing called “Boeing Fellow on Campus Program.”³ In that program, Boeing employees acted as adjunct or visiting faculty at universities where Boeing recruited engineering graduates. For those universities located at a distance, the Fellow temporarily lived on or near the campus during the course. However, that arrangement proved to be unsatisfactory for the employees and the program was eventually discontinued. Some universities have used industry to help teach senior design courses as part of capstone projects;⁴ Lehigh University refers to these adjuncts as “Professors of Practice.”⁵

Adjunct instructors from industry can temporarily replace faculty on sabbatical or on leave,⁶ handle temporary increases in student course enrollments,⁷ relieve full-time faculty so they can do research,⁸ or co-teach with full-time faculty to help bring professional practice into the classroom.⁹ For example, Texas Instruments helped co-teach a heat transfer course with the University of North Texas and provided students with examples of electronic cooling problems

and devices used to solve them.¹⁰ This was outside the scope of the typical heat transfer course and gave students a specific example of how the course materials were applied to actual industrial problems. Adjunct instructors can also teach specific topics in a course where faculty are less knowledgeable,^{11,12} teach entire courses outside the specific area of expertise of the faculty,^{7,13,14} and teach courses at off-campus locations.¹⁵ One example is using adjunct instructors from industry to teach courses in a non-traditional professional engineering and technology graduate (Masters) program.¹⁶

Industry Resources

Industry can provide cooperative positions and internships which allow students to work side-by-side with engineering professionals to see what they have learned in class and how it is applied in practice.^{17,18} Industry can provide paid part-time positions that are part of a work-study program required for a degree program.¹⁹ Industry can sponsor senior design projects to produce some type of product of interest to them, while simultaneously educating students by allowing them to apply their knowledge and skills to an actual problem.¹⁷ Industry can sponsor research projects with faculty that also include student workers. Industry can also provide facilities for students to conduct research if these are not available at the university.

Other

Industry can help provide new course content, for example for emerging technologies, which can be taught by academia.²⁰ Industry can partner with universities to provide guest speakers to enlighten students about various aspects of the “real world” of engineering.²¹ Many schools have a seminar series where different guest speakers from industry present each week to give students a broader view of various engineering disciplines. Companies can host field trips where universities visit local industrial facilities to see actual equipment in operation.²² Industry can provide formal mentors for university students and participate in supervisory thesis committees for graduate students,¹³ including sponsoring industrial theses that are carried out in industry.²¹

Adjunct Instructors

JZ has provided adjunct instructors for three different ORU mechanical engineering courses over the past three academic years: ME331 Applied Thermodynamics (Fall 2008, Fall 2009, Fall 2010), ME433 Heat Transfer (Spring 2009), and ME444 Experimental Methods (Spring 2010). The current plan is for JZ to provide instructors for ME331 each fall and ME444 each spring on an ongoing basis. To date, all courses have been taught by two JZ adjuncts (authors of this paper – two of whom have Ph.D.s and two of whom are P.E.s). ORU initially provided the most recent syllabus used for each course, which was then modified as appropriate. In the case of ME444, significant modifications were made including choosing a new course text and changing some of the course content.

ORU has been very flexible in working with the JZ adjuncts to offer the courses at times more convenient to full-time working engineers. Some of the courses have been offered early in the morning and some later in the afternoon. Some have been adjusted to meet twice a week instead of three times a week to reduce the number of trips for the adjuncts.

The JZ adjuncts have exposed the ORU students to many examples of actual industrial equipment utilizing the principles they have been studying in class. For example, many examples from JZ's business have been used in the combustion section of the Applied Thermodynamics course. These included photographs (see Figure 3) and video clips of actual operating equipment. In that case, the students were getting an industry expert on the particular topic as well as real examples of equipment designed using the principles they were learning in class. In many of the classes taught by the JZ adjuncts, the ORU students visited JZ to see actual industrial equipment related to the subjects being studied in class. For example, the students witnessed full-scale burners firing in pilot test furnaces (see Figure 4) while they were studying combustion in the Applied Thermo class and radiation heat transfer in the Heat Transfer class.



Figure 3. Photo of a JZ burner firing in a test furnace.

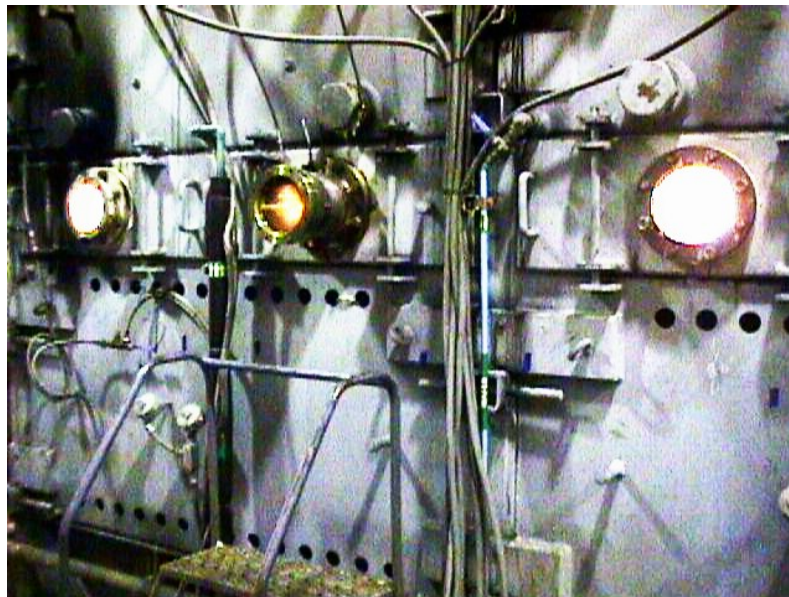


Figure 4. Photo showing thermal radiation emitted through the viewports of a JZ test furnace.

Other

Two of the JZ authors of this paper are members of the ORU Engineering Advisory Board. One of them serves as the chairman of the Research and Projects Committee. JZ has offered to provide a senior design project for the 2010-11 year. The project will investigate a highly technical concept that will require specialized equipment and which should generate unique data. This project could lead to a technical publication that would include the ORU students as authors. JZ has presented its technology at the ORU engineering seminar series. ORU hosted two regional ASME meetings where JZ presented a paper, gave an invited lecture, and provided a judge for some of the student contests. Although the economy has not been favorable for hiring new engineering graduates the past couple of years, JZ plans to consider ORU students in future hiring for both permanent and intern positions.

JZ has also been a major sponsor of the ORU Formula SAE Racing Team. The design and building of the racecar started out as a senior design project during the fall of 2009 and spring of 2010. This project has been initiated to attract students interested in engineering and to improve retention in the engineering program. Furthermore, JZ invited the ORU Engineering department chairman to present the ORU engineering program to prospective high-school students from the Tulsa Engineering Academy at Memorial High School that were visiting JZ on a field trip during spring 2010. The cooperation between JZ and ORU has therefore been helpful for ORU to recruit students and to promote connections with industry.

Conclusions

There have been some important benefits of this industry-university partnership to ORU, ORU students, and JZ. The partnership has been successful enough that ORU has continued to use JZ adjuncts beyond the sabbatical leave of one of its professors. ORU has not had to hire another full-time faculty member to cover some core ME courses. The students are being taught by “Professors of Practice” so they can see how the theories they learn are applied to actual engineering problems. They will have an opportunity to work on a challenging industrial senior design project and possibly co-author a technical paper. They will have a chance to demonstrate their skills and abilities to a local potential employer who could provide permanent or intern positions. They also receive some informal mentoring from the industry engineers. JZ benefits by having close access to potential hires. JZ engineers have the chance to teach relevant courses that help keep them technically sharp. An important element to the success of this partnership has been flexibility of both industry and the university.

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Biographical Information

CHARLES BAUKAL

Dr. Baukal is the Director of the John Zink Institute which is part of the John Zink Co. LLC (Tulsa, OK) which he has been since 1998. He has over 30 years of industrial experience and over 20 years of teaching experience. He is an adjunct engineering instructor at Oral Roberts University and the University of Tulsa. He has authored or edited eight books on industrial combustion.

JOE COLANNINO

Mr. Colannino received his undergraduate degree in chemical engineering from California Polytechnic University at Pomona and a Master of Science in Knowledge Management from the University of Oklahoma. He is responsible for global R&D and learning at John Zink Co. LLC. He has authored one book and many chapters on combustion modeling and related topics.

WES BUSSMAN

Dr. Bussman is a senior research and development engineer for the John Zink Co. LLC. He has 19 years of basic scientific research work, industrial technology research and development, and combustion design engineering. He holds ten patents, and has authored several published articles and conference papers and has been a contributing author to several combustion related books. He has taught engineering courses at several universities and is a member of Kappa Mu Epsilon Mathematical Society and Sigma Xi Research Society.

JOHN MATSSON

Dr. Matsson is a Professor of Mechanical Engineering and Chairman of the Engineering, Computer Science, Physics, and Mathematics Department at Oral Roberts University in Tulsa, Oklahoma. He earned M.S. and Ph.D. degrees from the Royal Institute of Technology in Stockholm, Sweden in 1988 and 1994, respectively.