
AC 2011-1677: DEVELOPMENT OF AN ADVANCED TECHNOLOGICAL EDUCATION CENTER FOR WATER TREATMENT

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Development of an Advanced Technological Education Center for Water Treatment

Introduction

It is often quite difficult for industrialized societies to recall the importance of a clean supply of water. However, its impact is unquestionable. In a study conducted by Esrey et al. (1991)¹, improvements in local water qualities via sanitation systems reduced such dreaded diseases as schistosomiasis and hookworm infection by margins as high as 78%. These improvements would not have been made possible without a trained and skilled workforce of water treatment professionals to ensure that the equipment functioned properly and maintained its disinfecting capabilities.

In the United States, however, the beginning of a shortage of these critical professionals is occurring as demand for them increases and the numbers within the workforce fall. According to the United States Bureau of Labor Statistics, between 2008 and 2018, employment of water and wastewater treatment operators is expected to increase by 20%, much faster than the average growth of other employment sectors.² In fact, according to the American Water Works Association (AWWA) and the United States Department of Labor, water and sewage systems are expected to be the only utilities which will be growing, in terms of employment, due to an increase in demand from new housing developments and new regulations requiring increased monitoring and treatment. Couple this with an aging workforce, 35% of which is expected to retire within the next ten years, fewer entrants into the industry, and more individuals pursuing four-year college degrees instead of entering the trade labor pool and the perfect cocktail for a labor shortfall is in place.³

Accompanying a decrease in numbers will be a simultaneous decrease of experienced workers within this field. The tacit knowledge required of water treatment operators, the type not documented in training manuals or textbooks, is of the utmost importance to maintaining the levels of water quality which utilities have provided and customers have demanded. Its only origin is from the proverbial “getting your hands dirty” approach, or in other words, learning the skills necessary by performing on-the-job tasks.⁴

These problems are exacerbated in rural areas where operators face lower wages, less benefits, and more responsibilities than their counterparts working at larger utilities. These factors, due to many small utilities receiving less competition from other utility sectors such as gas and electric for labor, and the social stigma of regarding water treatment positions as dead-end jobs, force many of the younger professionals in these areas to seek employment with larger utilities. This out-migration has left many small water utilities in a state of disarray as they struggle to find adequate employees to fill these irreplaceable positions.⁵

With these issues in mind, the Center for Water Resource Studies (CWRS) at Western Kentucky University (WKU), with funding from a National Science Foundation (NSF) Advanced Technological Education (ATE) grant (#0903286), formed the Water Training Institute (WTI) to provide the labor market with an influx of new water and wastewater treatment operators who

will possess many of the skills necessary to perform the tasks those retiring will leave. This two-year program leads to an Associate of Science Degree in Water Resource Management, with a plus-two option to pursue a Bachelor of Science in Technology Management.

Educational Methods

Pursuit of the Associate of Science in Water Resource Management has been tailored to meet the distance learning issues associated with rural areas, where the growing workforce crisis for water utilities is greatest. It has been documented by Katsinas (2007)⁶ that many times, individuals residing in rural areas have little to no access to higher educational opportunities. This has handicapped their ability to pursue advanced degrees and therefore, their ability to pursue training as a water or wastewater operator, which WTI offers.

In order to cope with this disadvantage, all courses that lead to completion of the degree are offered as web-based, online curriculum. This grants students, who may not have immediate access to a college campus, the ability to take classes without the limitations their geographic location presents.

There are some who find this form of education unfulfilling and lacking in comparison to the traditional form of education that occurs in a “face-to-face” manner, only available in a physical classroom setting. However, research by Steinman (2007)⁷ has found that when performed in a way which promotes interaction between pupil, instructor, and fellow students, web-based education can be just as effective at delivering a quality educational experience.

While the educational instruction provided via online coursework is instrumental in laying the foundation for creating a qualified water or wastewater operator, it lacks in effectively providing the hands-on activities required for licensure in the discipline.⁸ This is where the second part of instruction within the WTI educational model takes form; an internship within an active water or wastewater treatment facility. During this, students must take part in the day-to-day operations by working with current water and wastewater operators and administrators, to thoroughly get a sense of how the utility functions and how they will fit into the scheme of this design, once they become an employee.

This “learning-by-doing” model has been supported by both educational⁹ and economic¹⁰ experts alike. In fact, observations by T.P. Wright (1936)¹¹, an aeronautical engineer, found that the number of labor hours required to produce an airframe was inversely proportional to the number of airframes of the same type which were produced. What this means to developing water operators is that their educational training will function optimally if they perform tasks which are similar, if not the same, to those that they would perform during their careers. Therefore, the WTI program has embraced this time-tested philosophy.

In effect, the WTI degree program is designed to integrate the established hands-on requirements that operators must meet in order to maintain their licensure with a classroom educational component, ultimately fulfilling the belief that this will produce a better trained collection of operators who can meet the increasingly stringent water quality requirements set by local, state, and federal law.

Partnerships with Industry

The design of this educational system is holistically tied to effectively partnering with water and wastewater industries. Indeed, this method is critical for creating a curriculum that provides students with the skills necessary to become successful employees within the industry. Partnerships with industrial affiliates such as the Kentucky Water and Wastewater Operators Association (KWOWA), the Kentucky Rural Water Association (KRWA), the Kentucky/Tennessee Section of the American Water Works Association (AWWA), and the Tennessee Association of Utility Districts (TAUD), provide CWRS and WTI with a host of tools for recruitment, refinement, and establishment of a sustainable water and wastewater operator educational system through their involvement with WTI.

Industry and Education

Industrial partners have been utilized to form the WTI Utility Network (UNet), a system vital for providing students with the hands-on learning component of both their education and licensure as water operators. This organization is comprised of a host of utility and municipality partners who have agreed to grant students access to their facilities so that they may fulfill this requirement. It is hoped that through this process, students will become acquainted with the operations of the water utilities and also engage in networking opportunities for future employment after completion of their academic requirements. Participants within UNet are also utilized in the governance of the WTI program.

Water utilities have also been influential in the design of the coursework for students in the program. Through the WTI Steering Committee, participating utilities and trade associations have voiced their opinions about what knowledge, skills, and abilities a proficient operator should possess. This has allowed CWRS to create courses that emphasize these topics and enlist qualified instructors to deliver relevant instruction to students in the program.

Industry and Creating Incentives

Licensed water and wastewater operators are required to obtain relevant continuing education units (CEUs) in order to maintain licensure with state governments. Through successfully working with organizations such as the Kentucky Division of Compliance Assistance, which governs what constitutes CEUs, WTI courses can now be utilized to fulfill these requirements for current water and wastewater operators. Furthermore, students in the program receive one hour of institutional credit for every 80 hours of supervised, program-appropriate internship executed within a utility. Not only do these programs promote enrollment within WTI but they also attract current water and wastewater operators who can provide valuable feedback pertaining to the applicability of topics discussed within courses towards on-the-job activities. In effect, as these experienced operators pass through the educational system, they are helping to design and refine the coursework which will produce the water and wastewater operators of the future.

Utilities and trade associations are also working conjunctively with CWRS in developing a scholarship program for current or future students within the WTI program. KWOWA has established and awarded funding to one student participating in the WTI program. The Kentucky/Tennessee Section of AWWA has established funding for multiple scholarships and is currently refining an application and deciding upon the qualities the desired applicants will

possess. Funding is also available to students through some of the utility districts themselves via tuition reimbursement. These programs would not be possible without the direct involvement with both utilities and trade associations in the WTI program.

Current State of the Program

WTI is still in its infancy as an educational program. However, steps are being made to develop the curriculum, recruit new students into the program, and expand the program beyond its current regional setting. During the past year the program has transitioned from WKU's University College's Commonwealth School to the WKU Ogden College of Science and Engineering's Architectural and Manufacturing Sciences (AMS) Department. This move will further facilitate the transition of the two-year Associate of Science Degree in Water Resource Management into a Bachelor of Science in Technology Management (housed within the AMS Department), if a student desires to pursue a four-year degree.

Classes in the program were first offered during the Fall 2008 semester. Since that time, 49 students have enrolled in at least one of seven different courses offered to date, and four students have completed the program's internship requirements. While none of the students have yet to complete the entire program, there are ten students currently majoring in Water Resources Management, four of which are expected to graduate by December 2011.

Further, independent review by the WKU's Department of Psychology (2010)¹² was performed, in order to determine the status of employment within the water and wastewater industry and the impact completion of a WTI degree would have upon an applicant's ability to be hired. This survey, comprised of professionals currently within the water and wastewater industry, indicated that, of those surveyed, impending retirements are a problem for most organizations and that an associates degree would enhance an applicant's chances of being hired, their competitiveness for a management position, opportunities for advancement, and operator performance. However, this group also indicated an uncertainty pertaining to whether an associates degree would generate more employment interest than job experience and whether higher salaries would come to those who possess associates degrees.

Curriculum Development

Review of the thoroughness with which course topics are covering the issues that were identified as most important to water and wastewater utilities was again conducted by an independent reviewer within WKU's Department of Psychology. This examination consisted of a list of four positions which graduates of the WTI program would be likely to acquire post-graduation. These positions were: Water Treatment Operator, Wastewater Treatment Operator, Collection System Operator, and Distribution System Operator. Under each of these positions, lists of content areas important to each specific job were determined by surveying incumbents in these positions. These incumbents were then asked to rate the importance, difficulty to learn, and time needed to learn each of these categories. This data was then compared to the courses which covered these topics and how much emphasis was placed on each of these topics, based on responses from WTI instructors, using a matching matrix. This has given course designers an indicator of which subjects are being under or over-emphasized in courses and what future adjustments in curriculum content are necessary.

Recruitment

Representatives of WTI are regular attendees at meetings sponsored by trade affiliates, such as the Water and Wastewater Operator Expo hosted by KRWA, in order to promote and provide current water and wastewater operators with information about the program. Attendance at educator events, such as the annual Kentucky Association of Environmental Educators (KAEE) Conference, is also pursued in order to provide these teachers and educational administrators with information that can be passed to their students who may show an interest or aptitude in the program.

Recruitment of high school students into the programs is also being pursued through dual credit opportunities, talks with career and tech schools at regional high schools, and operators currently working in the industry who avail themselves to speak at career fairs. The WTI Recruitment Subcommittee has also begun the process of creating a regional competition for high school students, sponsored by local utilities, to create working water treatment models.

Also, it was determined from the previously mentioned study conducted by WKU's Department of Psychology (2010)¹³ that of those who participated in the survey, 65% felt that current employees would not benefit from completion of an associates degree, indicating that many current water or wastewater operators may not show interest in the program. However, the study excluded investigation of their interest in WTI as a means of acquiring continuing education units (CEUs).

Program Expansion

The CWRS is now in the midst of attempting to acquire additional funding from NSF to create a national center for WTI. This center would begin to expand upon the regional model developed in the Kentucky/Tennessee region by developing relevant curriculum and further facilitating partnerships between academia and industry. Currently, there is an assemblage of 19 partners, including CWRS, stretching from Massachusetts to Alaska, working together to make this national center possible. This group is made up of a variety of educational institutions, utilities, and technical assistance centers.

Conclusions

As the United States sees its largest generation, the baby-boomers, begin to retire in the coming years, there will undeniably be pressure upon several sectors of the economy, including the water utility industry. The Water Training Institute is working towards training a workforce which will ease this burden and allow water utilities to continue to provide the same clean, safe water Americans enjoy. WTI is continuing to transform training within this established industry into one equipped for the 21st century by providing students with distance learning opportunities through online curriculum, allowing them to participate in learning experiences that were once impossible to attend. It is believed that this educational model will increase participation among the rural residents of America and solve the problems associated with geographical limitations. Continued recruitment of prospective future professionals will be pursued by visiting area high schools and providing information to secondary education professionals.

However, none of these changes would be possible without explicit cooperation with the utilities and professionals currently working in the industry. Their contributions range from assisting in

the development of the curriculum to providing facilities and internships for students, and granting CEUs to current water and wastewater operators. In summation, their participation is as important to the success of the WTI program as a reliable internet connection. Without the latter, students are unable to participate in coursework. Without the former, the educational system will struggle to remain relevant to industry needs. Therefore, continued partnerships with industry will work to ensure that the Water Training Institute meets the water industry's employment needs, both in quality and quantity.

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