AC 2008-269: INCREASING AWARENESS ABOUT SERVICE INDUSTRIES OPPORTUNITIES FOR IET AND IE GRADUATES

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Increasing Awareness About Service Industries Opportunities For IET and IE Graduates

Today's global economy has significantly affected job opportunities for Industrial Engineering Technology and Industrial Engineering graduates. Fortunately, IET and IE are adaptable degrees. The tools and techniques taught IETs and IEs focus on productivity, costs, quality, and safety. Can you think of any organization, anywhere in the world, that wouldn't want to improve in these areas? While the face of American manufacturing continues to evolve, opportunities for IET and IE employment in the service industries are on the upswing. Still, few newly-minted graduates seek employment in the service industries. So, if the opportunities for service industry employment are increasing, why aren't more IETs and IEs seeking employment there? One reason may be that undergraduates may not have thought about seeking service industry jobs. There may be a lack of awareness of how to apply their tools and techniques outside of manufacturing. They may not be able to picture what a typical workday might be like. A review of textbooks, teaching materials, and courses shows a lack of examples provided during their education. This lack of exposure to service industry examples and applications may be limiting IE and IET graduates' job searches.

At the University of Dayton, the IET program has made a focused effort to improve student and industry awareness of service industry applications for IE and IET techniques. This paper details the program changes, curriculum and coursework adjustments that have been made, as well as what has been learned along the way. The paper provides ideas and recommendations on how to enhance service industry awareness among undergraduates.

Where are IEs and IETs employed?

The succinct answer to this question is: everywhere. An advertizing poster from Institute of Industrial Engineers' (IIE) displays three service industries examples: entertainment, healthcare, and distribution; compared to only one manufacturing industry (automotive) example. This makes sense when you consider that 60% percent of consumer expenditures are for services versus 12% for durable goods. In the past 10 years employment in the manufacturing sector has declined from over 17% to just 11%, while employment in healthcare, logistics, and other service industries has risen from 13% to 17%. (Summers, 2006) The U.S. Department of Labor, Bureau of Labor Statistics (BLS) describes industrial engineers at their website www.bls.gov/oco/ocos027.htm , stating that industrial engineers determine the most effective ways to use the basic factors of production—people, machines, materials, information, and energy–to make a product or to provide a service.

The BLS expects that the long-term shift from goods-producing to service-providing employment will continue. Service-providing industries are expected to account for approximately 18.7 million of the 18.9 million new wage and salary jobs generated over the 2004-14 period. During that time, approximately 3 out of every 10 new jobs created

in the U.S. economy will be in either the healthcare and social assistance or private educational services sectors. Healthcare and social assistance—including private hospitals, nursing and residential care facilities, and individual and family services—are projected to grow by 30.3 percent and add 4.3 million new jobs. Employment growth will be driven by increasing demand for healthcare and social assistance because of an aging population and longer life expectancies. Employment in administrative support and waste management and remediation services is projected to grow by 31 percent and add 2.5 million new jobs to the economy by 2014. Service industries have accounted for almost all U.S. job growth since the 1960's. Wages in the service sector overall have risen faster than wages in most other sectors.

The Bureau of Labor Statistics has the most complete information concerning IE and IET employment. Analysis of their data is somewhat limited due to the lack of information about job titles or degree types. Another gap in the data concerns the other job titles that IEs and IETs assume. As the website is currently designed, data are available about people using the job titles of IE and IET while holding industrial engineering, managerial, or educational positions. Determining the number of IEs and IETs employed as cost estimators, sales engineers, compensation and human resources personnel, purchasing agents, engineering managers, insurance appraisers, schedulers, supervisors, and other occupations is not feasible.

On the BLS website, Category 17-0000, Architecture and Engineering Occupations, lists 2006 engineering employment as 2,430,250 people who have a mean annual wage of $66,190. (www.bls.gov/oes/current/oes170000.htm) Category 17-0000 is broken down into over 30 sectors. Of these, 23 have engineer in the title. For purposes of this paper, the most appropriate categories are 17-2112 Industrial Engineers and 17-2111 Health and Safety Engineers.

The Bureau of Labor Statistics (BLS) describes category 17-2112, industrial engineers, with the following statement:

> 17-2112 Industrial Engineers: Design, develop, test, and evaluate integrated systems for managing industrial production processes including human work factors, quality control, inventory control, logistics and material flow, cost analysis, and production coordination. Exclude "Health and Safety Engineers" 17-2111.

The BLS reports that as of May 2006, the category 17-2112, Industrial Engineers, employed 198,340 people. Their mean annual wage was $70,630. The employment root mean square (RMS) is 1.3% and the wage RMS is 0.3%. (www.bls.gov/oes/current/oes172112.htm)

The Bureau of Labor Statistics (BLS) describes health and safety engineers with the following statement:

> 17-2111 Health and Safety Engineers, Except Mining Safety Engineers and Inspectors: Promote worksite or product safety by applying knowledge of industrial processes, mechanics, chemistry, psychology, and industrial health and safety laws. Include industrial product safety engineers.

Category 17-2111, Health and Safety Engineers, Except Mining Safety Engineers, had an employment of 24,620 with a mean annual wage of $68,400. The employment RMS is 2.9%, while the wage RMS is 0.6%. (www.bls.gov/oes/current/oes172111.htm)

When accessed, each major category provides several pre-prepared charts. Besides the succinct summary of national employment and wage estimation already provided in this paper, the other charts available for each occupation include percentile wage estimates and lists of the top five industries with the highest levels of employment, the top five paying industries, the top five states with the highest concentration of workers, and the top five highest concentration and highest compensation metropolitan areas.

Within each category, information is available for a variety of different industry sectors, including mining (21), utilities (22), construction (23), manufacturing (31, 32, 33), wholesale (42) and retail (44, 45) trade, transportation and warehousing (48, 49), information (51), finance and insurance (52), educational services (61), healthcare and social assistance (62), arts, entertainment, and recreation (71) , government (99) and others. Users can customize data tables through the use of a variety of predetermined questions provided by the BLS. Data available includes industry, employment numbers, hourly mean wages, annual mean wages, hourly median wages, percentiles, and percentage errors. Our interest focused on the service industries, eliminating mining and manufacturing from our study. Out of a total of 198,340 industrial engineers, this eliminated 142,620 manufacturing and 1,350 mining engineers. Industrial engineers in the service sector total 54,310. The breakdown is shown in Figure 1. Health and safety engineers employed nationwide number 24,620. Subtracting manufacturing and mining, for the service industries, the breakdown is shown in Figure 2. These figures must be taken with caution. Not only are there jobs that are not tracked for industrial engineers, the percentage error for each category ranges from 0.3% to nearly 50%. The largest RMS error found in the categories related to pay. Still, it is the best data available.

People with the job title of industrial engineer comprise 8% of engineers nationwide. Add in those using the title of health and safety engineers and that percentage rises to 9%. Since the BLS does not provide degree qualifications, the numbers in this paper must be taken as ball-park figures. Within industrial engineering, 27% of the jobs are in the service industries. Looking at data for the top five industries with the highest levels of employment, the top five paying industries, the top five states with the highest concentration of workers, and the top five highest concentration and highest compensation metropolitan areas supports the conclusion that an IE or IET in the service industry is still a non-traditional employment opportunity. Yet, as the face of U.S. employment opportunities continue to evolve, these percentages can be expected to increase.

Category	Employment
utilities (22)	1,640
construction (23)	1,100
wholesale trade (42)	5,800
retail trade (44, 45)	450
transportation and warehousing (48 and 49)	1,990
information (51)	2,930
finance and insurance (52)	350
professional, scientific, and technical services (54)	24,990
management of companies and enterprises (55)	8020
administrative and support and waste mgmt. and remediation services (56)	4,330
educational services (61)	290
healthcare and social assistance (62)	240
arts, entertainment, and recreation (71)	40
other (81)	360
government (99)	1,780
Total	54,310

Figure 1: Bureau of Labor Statistics Employment Records for Industrial Engineers in the Service Industries

Category	Employment
utilities (22)	430
wholesale trade (42)	470
retail trade (44, 45)	30
transportation and warehousing (48 and 49)	650
information (51)	80
finance and insurance (52)	510
professional, scientific, and technical services (54)	3,840
management of companies and enterprises (55)	810
administrative and support and waste mgmt. and remediation services (56)	1,700
educational services (61)	320
healthcare and social assistance (62)	500
government (99)	2,930
Total	12,270

Figure 2: Bureau of Labor Statistics Employment Records for Health and Safety Engineers in the Service Industries

What are IEs and IETs in the service industries doing in their jobs?

Anyone who has been in the industrial engineering profession for any length of time recognizes that job opportunities for IEs and IETs are evolving. More and more graduates are being hired in non-traditional work environments. The statistics presented in this paper show that a significant percentage of industrial engineering jobs exist in the service sector. IE and IET graduates with an understanding of service industries are needed to fill these jobs. Universities must teach them how to adapt and apply their knowledge and skill set to service industries.

In April of 2005, we surveyed our university's engineering technology students to determine their interest in service industry topics. The survey asked three questions:

> 1. Have you considered working in the service industries (hospitals, banks, government, logistics, food services, transportation, etc.) upon graduation?
>
> 2. Would you be interested in taking a course entitled IET Applications in the Service Industries?
>
> 3. Would you like to see more cases related to the service industries utilized in existing classes?

Student response was overwhelmingly positive, revealing to us that our students, regardless of their year, were fully aware of the changing job market (Summers, 2006). Further discussion with our industrial advisory committee members reinforced our desire to expand service industry topic coverage in our courses.

Our initial investigations revealed that within our program, service industry applications had not translated well into course exercises or examples. For this reason, a sabbatical for a faculty member was requested. The primary goal of the sabbatical was the creation of eight to ten in-depth cases showing the application of IE/IET tools and techniques to problems in healthcare, logistics, transportation, banking, insurance, e-business, environmental protection, and other services into its core courses. The cases and course materials developed during the sabbatical will enhance our students' skill set, increase our students' knowledge of the variety of job opportunities available upon graduation, establish connections with area service industries, and enable us to market our program more effectively to a broader range of potential students in the future.

Critical to this project is the involvement of IE/IET professionals. Our graduates provided the greatest number of contacts. When contacted, each of them knew of several colleagues who held IE positions in the service industry. Through them we were able to locate graduates who worked at places like DSW Shoes, Remodeling Designs, PNC Bank, 5/3 Bank, Kroger, Health Alliance, Miami Valley Hospital, Clinton Memorial Hospital, Wellpoint Insurance, Montgomery County Public Works, Dayton Power and Light, Bureau of Worker's Compensation, Miller Valentine Construction, The Air Force,

Strategy Three Consulting, and CNA Insurance. Interacting with IE professionals resulted in a variety of outcomes including:

- A network of local IE/IETs working in service industries who are willing to serve as guest speakers, mentors, and job shadowing and project experiences.
- Increased faculty awareness of the applications of IE/IET techniques to the service industries through the addition of service industry materials into their courses.
- Over 40 timely articles describing service industry applications of IE/IET tools and techniques.
- Recruiting tools to show potential students and their parents opportunities in the service industries.
- Creation of 35 in-depth cases and examples based on actual service industry experiences (Figure 3). Material for 10 more cases has been gathered.

Course/Topic	Number	Focus
Cost estimating	Two	Case from home remodeling emphasizes project labor, material, overhead calculations.
Facilities layout	Two	Cases from warehousing focuses on RFID's and material, people, and information flow.
Human factors	Five	Cases from hospitals, pharmacies, dentist office, and call center focus on human error consequences, human information processing, and job redesign.
Project management	One	Case focuses on creating project proposals and plans for the home building industry.
Quality Assurance	Nine	Cases focus on quality improvements in banking, logistics, hospitals, and offices.
Work measurement	Four	Cases from banking, grocery stores, and warehousing focus on productivity improvement through hob redesign, effective workstation design, and time standards.
Production management methods	Three	Cases focus on supply chain management, distribution, and lean thinking.
Cost control	Two	Cases from a hospital and an insurance company focus on financial decision making in the purchasing department.
Industrial and environmental safety	Three	Cases from hospitals focus on fire safety, disaster planning, failure modes and effects analysis, and hazardous materials.
Economic analysis	One	Case from insurance company focuses on cost benefit analysis.
Management of people	Four	Cases from banking, insurance companies, and call centers focus on hiring, termination, and turnover issues.

Figure 3: Case Topics

We specifically chose to work with IEs who had been in the field for five or more years. Often they worked as the only IE in their organization. This did not appear to be related to the size of the company, but, rather, to the leadership's understanding of the benefits

that IEs provide. Investigation revealed that the greater the understanding of how IEs can help improve cost, safety, productivity, and quality, the greater the number of IEs in the company.

Many of the IEs had come from a manufacturing background and tended to find their current employers somewhat behind in applying traditional IE tools and techniques to improve quality, productivity, safety, and costs. Many of the issues they faced focus on processes that were unclear, highly variable, and not standardized. On the surface, these often appeared to be personnel issues. The most commonly used tools were related to quality (control charts, Pareto diagrams, flowcharts), safety (preliminary hazard analysis, failure modes and effects analysis), human factors/ergonomics (work place redesign, visual displays, human computer interface), and lean (productivity analysis, 5S, value-added process mapping). These tools were most commonly applied to process improvement and human resources issues. Cost information was by far the most difficult to get. In some cases, this was because of privacy issues, but in many companies the information was not tracked.

Case study creation took place during the Summer and Fall of 2007. During the 2008 Winter term, ten of the cases were used in a classroom setting. The rest will be used when their respective courses are taught in the Fall of 2008. Though only anecdotal data was available at the time that this paper was written, the cases were very well received by the students and the faculty using them. The students found them more interesting to work than shorter assignments and because the cases unfold in a step-by-step manner, the students understood the thought process behind where and how the tools and techniques were applied. Formal tracking will occur through the end-of-semester course evaluations.

The cases are designed to provide students with opportunities to identify, analyze, and solve real world problems in the service industry. They focus on the application of IE/IET tools and techniques. All cases were created using data gathered at service industries. Many require outside research. One particularly successful work measurement case focused on check processing at a bank. Students use several mock workstations to perform and time the operations necessary to receive and process a check through a bank. These steps include: open envelop, remove check, scan check, record check information, copy check, and place in appropriate processing tray. During the five part case, the students had to measure work and study motions. They analyze the data and videos of their activities and design workplace improvements. After making improvements, they perform the operation again and measure the success of their changes against their original findings. A second successful case focused on quality improvements for scheduling hospital surgical preparation procedures. The nine part case provides background about preparing patients for surgery, ask students to map the process, define customer needs, analyze survey data, and determine the changes necessary to improve the process. An example of the cases is not provided here due to space limitations.

IE/IET faculty are aware of the need to cover service industry applications in their courses. As previous investigations show (Summers, 2006), these efforts are usually dependent on the individual faculty member and are not necessarily seen curriculum-wide. At the University of Dayton, our goal is to integrate service industry activities and examples across the curriculum. From the very beginning of this project the approach was as integrated as possible. Since the cases were developed for use in a wide variety of classes by a single faculty member, care was taken to gather input from those who would be using the cases in the future. To avoid the 'not invented here' syndrome that could potentially develop when multiple faculty members use the work of a single faculty member, throughout the creation of the cases, input was sought from future users. From the very beginning, all faculty members were encouraged to provide insight into the types of cases they would like to use. As the case studies were being developed, regular communication kept faculty up-to-date. Modifications to the cases were made whenever necessary. Detailed background information, as well as detailed answers were provided. Before using each case, the developer and the user met to walk through the case, highlighting key points. For these reasons, the cases were well received by the faculty. This process was critical to the success of these cases.

How can IEs and IETs in the service industries help us?

The key benefit of all this interaction with IE/IETs in the service industries was the creation of in-depth case studies and examples to be used in courses. Developing the cases was not straightforward or easy. As busy professionals, our graduates didn't mind being shadowed, but they were not really interested in helping write cases or examples. In other words, they were happy to see us, but they didn't really want any more work to do. Each connection began with an explanation of the amount of input they would need to contribute. We were very clear about limiting their involvement to the privilege of shadowing them for a day, their list of the three key things they thought undergraduates should know, their input into case ideas, and the use of their data.

We stressed that they are making the learning experience real by providing the story and information behind the application of a particular tool or technique. The method used to create cases and examples involved establishing the professional connection, shadowing, volunteering to help solve a problem with them on their job, solving the problem, writing up the activities that took place in case study format, reviewing the case with the professional, and preparing the final copy.

So how can you get professionals to help you? When they ask what they can do to help, respond clearly with your needs. We limited our specific requests to:

- Provide a list of three key things our graduates have to know
- Provide ideas
- Provide job shadowing experiences
- Provide data
- Provide structure and background for a case
- Provide tours.

Some key thoughts to keep in mind while working with them are:

- Job shadow the professional for 4 or more hours to get a better feel for what they do and how that information can be turned into an interesting class example, case, or problem.
- Be very flexible with availability times
- Be like a fly on the wall, do not interrupt them while they are working
- Ask their advice on the three things they consider most important to their jobs
- Think carefully about the three most important points you want to get across to your students for a particular case, example, problem
- Discuss the points you would like to get across to your students with the professionals, match those with what they consider important
- Take detailed notes of your visit
- Take detailed notes related to the case, example, or problem as it develops
- Ask early, ask often for necessary supporting data
- Be patient while they check with superiors for permission to use the data
- Let them see the drafts for the cases, examples, and problems
- Follow-up on their suggestions

The assistance of practicing professionals provides interesting information that can be used to help interest students in industrial engineering tools and techniques. They are the best source of information to help attract more IEs and IETs to the field.

Students and faculty have raised concerns about increasing awareness in service industry firms about how IE/IETs can help improve productivity, quality, costs, and safety. In many cases it is up to the individual seeking a job to point out the correlation between the industry needs and their skills. Perhaps this is why many IE/IETs switch from manufacturing jobs to service industry jobs later in their career. After getting some work experience under their belt, they are better able to sell themselves to industries that have not recognized their need. The use of cases and examples in our curriculum should help this. The cases raise student awareness about job opportunities, job titles, and the application of tools and techniques. Their increased knowledge should help them sell themselves better. It should also help them recognize job titles that on the surface do not seem related to IE/IET: HR Specialist, Quality Leader, Principle Consultant, Performance Improvement, Care Management, and others. We have already seen this happen when a student approached a banking firm at a career fair and proceeded to tell the recruiter about the case he had worked on. The end result was a job interview for the individual.

Conclusion

Given the increase in the number of service industries in the United States, industrial engineering and industrial engineering technology programs can no longer rely solely on instructors who have service industry knowledge in their backgrounds to inform students about opportunities. As more and more opportunities become available for IE/IETs in service industries faculty members and students need more exposure to service industry

applications as they relate to coursework. Students need projects specifically designed to show how their learning can be used to enhance operations in a service industry such as logistics, transportation, airlines, hospitals, construction, and government. This means that IE/IET programs need to develop a plan of action to integrate service industry applications into the curriculum. What should be done?

-Establish connections with service industries in your area. Investigate how they use the skills and techniques you teach to solve their problems.

-Increase the number of student projects involving interaction with service industries.

-Increase the number of examples, cases and plant tours related to service industry applications.

IEs and IETs are skilled at improving quality, productivity, safety, and cost. Making these improvements in the service industries is a viable employment source for IEs and IETs. Hospitals, warehouses, insurance companies, banks, and offices need industrial engineering tools and techniques to improve processes and customer services. Transportation and logistics opportunities are constantly expanding to support global movement of goods. It is critical to define new applications to industrial engineering and industrial engineering technology education and skill sets. Building the expertise to prepare students for both manufacturing and service environments will prove to be an attractive alternative for potential students. The service industries can provide challenging and exciting career opportunities to individuals with the right skills and motivation. It is important that these skills be developed through higher educational institutions.

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