FERRIS STATE UNIVERSITY

COLLEGE of ENGINEERING TECHNOLOGY

HVACR PROGRAMS

ACADEMIC PROGRAM REVIEW REPORT

AAS, HVACR TECHNOLOGY

BS, HVACR ENGINEERING TECHNOLOGY AND ENERGY MANAGEMENT

2012

Ferris State University

College of Engineering Technology

School of Built Environment

AAS in HVACR Technology & BS in HVACR Engineering Technology and Energy Management

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Section 1 – Program Overview

A. Program Goals

1. Program Goals and their Establishment

   a. **<u>HVACR Technology Program (AAS Degree):</u>**

      i. Established in 1945, the Ferris State University, HVACR Technology program has a sixty seven year history of high quality technical career-oriented educational offerings that provide the State of Michigan and the nation with prepared HVACR technicians. The mission and goal of the program is to educate students for positions in field service, design, engineering laboratories and service technology at the upper level of the technological spectrum in the HVACR industry. The program works closely with an advisory board of active industry personnel to ensure goals meet the current needs of the industry.

   b. **<u>HVACR Engineering Technology and Energy Management (BS Degree):</u>**

      i. Established in 1984, the Ferris State University, HVACR Engineering Technology and Energy Management program has a twenty eight year history of high quality, unique technical career-oriented educational offerings. This program was developed to meet the needs of the first National Energy Act of 1978 and has continued adjusting to energy management faced by the nation. The mission of the program is to develop the professional skills and attitudes in students, necessary to measure, monitor, control and maintain HVACR systems at optimum performance.

2. Changes in Program Goals and Preparing Students for Careers

   a. **<u>HVACR Technology Program (AAS Degree):</u>**

      i. The goals at the program level have not changed since the last program review but have changed slightly at the course level to meet changing industry demands. Our advisory board works well with faculty to update labs. Employers (from all parts of Northern America) regularly contact the University for graduates.

   b. **<u>HVACR Engineering Technology and Energy Management (BS Degree):</u>**

      i. This program has gone through some minor changes since the last program review. In response to industry requests, the program added a course (HVAC 350) that covers HVACR contracting topics. The load calculation course (HVAC 342) had a name change to reflect the coverage of energy modeling. The program changed the name of the degree to reflect the emphasis on energy efficiency. When the program was started in 1984, the degree was a BS in Energy Management but was changed to a BS in HVACR Engineering Technology in 1990 to reflect the broader capability of the graduates. The program now has reintroduced the term energy management to the degree title. The online BS degree now has students from around the world.

3. Relationship of Program Goals to the University's mission
    a. **<u>HVACR Technology Program (AAS Degree):</u>**
        i. The program is in complete compliance with the mission of the university with the students receiving a practical education that leads directly to employment anywhere in the world. The skills learned at Ferris prepare them to be immediately productive to their employers.
    b. **<u>HVACR Engineering Technology and Energy Management (BS Degree):</u>**
        i. This program is also in complete compliance with the mission of the university with the students receiving a practical education that leads directly to excellent paying positions anywhere in the world. Again, the skills learned at Ferris prepare graduates to be immediately productive to their employers, often put in charge of new engineering graduates from other colleges and universities.

B. Program Visibility and Distinctiveness

1. Description of Program Unique Features
    a. **<u>HVACR Technology Program (AAS Degree):</u>**
        i. The associates degree program has modified its curriculum through the years to stay in tune with the university's mission, including research with replacement (non CFC, ozone depleting) refrigerants and development and administration of nationally mandated refrigerant recovery certifications. This program has a 100% placement of its graduates filling positions at the community, state and national level. Ferris is one of the primary sources of degreed HVACR technicians provided to the State of Michigan. The program also provides technical information and services to the industry on a continual basis, conducting technical seminars that attract participants from across the nation. Faculty contribute to monthly news magazines in the field of refrigeration and air conditioning that also gives the program notoriety. Thirty percent of the graduates of this program go on into the Ferris HVACR Engineering Technology and Energy Management program. There are now over 250,000 HVACR technicians that have received their refrigerant recovery certification from Ferris. There are very few, if any locations in the nation in the HVACR field that have not heard of Ferris State University. Trade involvement, faculty and students regularly attend ACCA, MSCA and MCAA sponsored events in order to increase their knowledge of cutting-edge technology in HVACR and host seminars for new products as well as existing products. Community Service, faculty and students are involved in "Heat's On", a volunteer program that ensures low-income housing has adequate HVACR inspections and that systems operate reliably. This program is conducted for the local community with the help of local contractors. Currently faculty in this program are working with the DOE and National Renewable Energy Laboratory on a research grant to increase residential home energy efficiencies. Other partners in this research grant are Dow Chemical and Michigan State University.

b. **<u>HVACR Engineering Technology and Energy Management (BS Degree):</u>**

i. This degree fills the gap between the HVACR field technician and the Mechanical engineer and has gained international recognitions. Since 1997, the students from this program have competed in the ASHRAE (American Society of Heating Refrigerating and Air Conditioning Engineers) international HVACR design and system selection competition. The competition comes from Engineering schools from around the world and the Ferris HVACR program has dominated. Since entering the competition, the Ferris HVACR students have placed first 9 times, second place 5 times and third place 3 times. This is a record not matched by any other college and is phenomenal considering HVAC system design and selection is only one aspect of what the students are learning. The program has several other unique relationships with community, state and nation. The students are required to do a summer internship between the junior and senior year. During the internship, the students must apply the knowledge acquired during the junior year. This gives the students a chance to apply skills learned at Ferris in a real work setting. The internship is also a winning relationship for the companies that hire the interns for the summer. Companies not only get a productive employee for the summer, but a potential future employee after graduation. A large number of graduates return to work at the location that they interned. There are currently internship sites across the nation. Another unique relationship that the BS program has with the community and state is the Energy Audit course. During the fall semester of the senior year, students take HVAC451, which requires them to do a comprehensive energy audit on a real building for a customer. The students collect and analyze data from the building and put together a written report outlining the findings. The students must also give a presentation to the owner regarding the findings of the audit. This is a win-win situation for the student and the building owner. The owner gets valuable information on how to better use resources and the students get valuable written and verbal communication practice. The news that our program does full technical assistant energy audits has travelled around the state and region which has caused a waiting list to have our students come and do an energy audit. Graduates from the Ferris BS program will serve business and industry in the community, State of Michigan and the nation in the following areas:

1. Perform energy audits and complete energy / economic building and system analysis
2. Identify, recognize and recommend solutions to problems encountered in HVACR systems found in commercial and industrial buildings
3. Test, adjust and balance mechanical systems and controls for optimum comfort and economy
4. Optimize building and system operation through the utilization of

digital controls and state of the art facility management systems

2. Describe the Program's ability to attract quality students

   a. **HVACR Technology Program (AAS Degree):**

      i. Other than the long history of graduating quality graduates in the HVACR technology area, another main draw for new students is the Granger building. This building has enough room in the laboratories to have a wide range of equipment and the ability to allow one student to work on a piece of equipment at a time. This is not the typical case with other schools programs, where a number of students have to work on the same piece of equipment at the same time. Granger has state-of-the-art laboratories, lecture spaces and computer spaces with the latest technologies to enhance the students learning experience.

   b. **HVACR Engineering Technology and Energy Management (BS Degree):**

      i. The reputation of the Bachelor's program in HVACR and Energy Management is gaining notice nationwide as evidence of our highly successful internship program and continuing work with articulation agreements throughout many states in North America.

      ii. The visibility and distinctiveness is also continued on the international front with the on-line BS HVACR degree. The program now has students from around the world and is currently the only way students with a two year HVACR degree can complete their BS degree in HVAC without moving to Big Rapids or to Pennsylvania.

3. Identify the institutions that are main competitors for prospective students

   a. **HVACR Technology Program (AAS Degree):**

      i. There are a number of other two year HVACR programs in Michigan but none have the reputation, facilities and faculty that Ferris has. With this said competition for students in the two year program has become stiffer in recent years because of the cost per credit hour compared to other two year programs in Michigan. Now that the HVACR Technology Program has a new building, a stable, knowledgeable staff and an aggressive marketing campaign, the enrollment has been consistent.

   b. **HVACR Engineering Technology and Energy Management (BS Degree):**

      i. This program is only one of two programs in the nation providing a laddered baccalaureate program for associate degree graduates in the HVACR field, emphasizing the HVACR applied engineering. The Penn College BS degree maintains focus on HVACR which is slightly different than Ferris's BS program which expands the focus to building energy management.

C. Program Relevance

1. Labor Market Demand Analysis

   a. **HVACR Technology Program (AAS Degree):**

      i. The associate's degree program is locatable in the US Dept. Labor Market

Job prediction web site. The current projection for this degree is an **increase demand of 34% (Much faster than average).** (see appendix 1)

b. **HVACR Engineering Technology and Energy Management (BS Degree):**

i. The BS degree program is more difficult to get accurate numbers. Many different areas hire our graduates (see below) from the building automation industry to the energy industry. None of these areas have categories in the US Labor Dept. job outlook area; however, there are close categories (see appendix 2). The graduating class of 2011 were placed in the following job positions:

1. • Control technician
2. • Product design engineer
3. • Design analyst
4. • Sales engineer
5. • Application engineer
6. • Control project manager / engineer
7. • Assistant project manager (BIM)
8. • Energy solutions manager
9. • Control assistant project manager
10. • HVAC control planner / inspector / analyst
11. • Control systems tech.
12. • Equipment sales rep.
13. • HVAC marine engineer
14. • Control commissioning agent
15. • Energy auditor

ii. The automated control industry hires the majority of our graduates for a variety of positions. The within the industry, position areas include, controls, commissioning and energy. The main goal of all these positions is to ensure that buildings are using energy in the most efficient manner. This has been an important employment area since the first oil embargo of 1974 and continues that way today. As stated earlier, because our program is unique, there is little or no competition for the jobs in these areas. Our program has been in place long enough that past graduates are now the recruiting agents for their employers and are coming back and hiring more Ferris BS HVAC grads. The companies would include: Johnson Controls, Honeywell, Siemens, Trane, Carrier, etc. There is no reason to suspect that demand for graduates in these areas will diminish. Effective and efficient use of energy is still crucial to this country. Several of the career positions our graduates enter today did not exist 10 years ago due to the demand for energy efficiency.

2. Response to market and discipline changes: Our program's response to changes can be placed into three categories, information input, dissemination of input and reaction to

input.

a. Information input: There are several mechanisms by which our program keeps up with changes to our discipline. The first is our advisory board, which is made up of members from all of the market areas that are students may become employed. We try to maintain a diverse membership and rotate members on a regular basis. There is also one member position that is reserved for a recent graduate. Having a recent graduate has increased the communication that our current students have with the advisory board. Also having a recent graduate allows us to get feedback of our program in a shorter turnaround time. The second is the summer internship, which allows our program to get feedback from industry on a timely basis. Both students and the summer internship coordinator work or meet with employers during the summer and get information on the status of our profession. Most changes in our program to meet industry needs come from this source. The third method of input is more traditional, with faculty and students going to seminars, conventions, meetings and workshops in our field. This would also include faculty and students being members of professional organizations and getting journals and newsletters covering current topics in our field.
b. Dissemination of industry needs happen through faculty / student meetings. The advisory board meets two times a year and discusses topics. The internship coordinator has the summer interns keep journals which covers what their work responsibilities area. This information, along with the information from the on-site meeting is shared with other faculty members and any potential change in our curriculum is discussed. All professional development opportunities that our faculty attends require a summary of what was discussed or learned. This is another way information on industry changes are spread.
c. Finally, all the information that comes back to our program is analyzed to determine how our programs fit with current industry requirements. If there are small changes needed, the programs look at how these changes can be instituted into existing courses if there is room. This happens at least on a semester basis. If there is a major issue, such as a new class being required, the proper paper work is filled out and the process of going through curriculum review is started. Our programs are in a constant state of change to keep relevant with industry. The most recent major change came two years ago with the addition of an HVAC contracting issues course. This came about from input from industry, primarily from summer interns and past graduates.

3. The following statistics were taken from the most recent compiled student surveys: The following responses were to the question: How did you learn about your Ferris program? (Indicate all that apply).
    a. 34% - Other (Family, friends, friends that attended, friends in the program)
    b. 23% - Voc. / Tech. school teacher / counselor
    c. 11% - Advisor from another college
    d. 8.5% - HVACR program marketing person
    e. 8.5% - Site tour while in high school
    f. 5% - HVACR faculty visit to other school

g. 5% - General marketing
h. 2.5% - High school teacher / counselor
i. 2.5% - While attending another program at Ferris

j. The 2 year program has a long history and we are now teaching grand kids of pervious graduates. This explains part of the dominate response above. The 4 year program is the only way a two year graduate in HVACR Technology can get a BS degree related to the HVACR field. The program has been in place long enough that word of mouth across the nation has lead to students, especially in our on-line BS degree
k. Using the most recent compiled graduate and student surveys, the most important results relating to how well our program meets students expectations are the following:
    i. Question - I rate the quality of my curriculum as good.
        1. 95% - Strongly Agree
        2. 5% - Somewhat Agree
        3. Note: This is 100% of the students surveyed with NO disagreement!
    ii. Question – I would recommend this program to others.
        1. 97.5% - Strongly Agree
        2. 2.5% - Somewhat Agree
        3. Note: This is 100% of the students surveyed and again NO disagreement! See student comments regarding recommending this program to others on next page
    iii. Question – Overall, I am very satisfied with my education at FSU.
        1. 80% - Strongly Agree
        2. 20% - Somewhat Agree
        3. This not only takes in our program but their overall education at Ferris
l. Student comments on why they would recommend program to others
    i. " I would definitely recommend my program to interested persons in HVACR or Mechanical engineering. It is a very valuable and specialized degree with great career opportunities."
    ii. "I would highly recommend this program to anyone interested in HVACR."
    iii. "The HVAC industry is always evolving and we will always need people in the program"
    iv. "If they want to learn HVACR, this is the place to do it."
    v. "I would recommend the HVACR programs because of the facilities and knowledgeable instructors."
    vi. "Absolutely, because of the 100% job related employment"
    vii. "Good education and good job placement"
    viii. "If you are interested in HVAC, this is the school to attend. The job market for our field is plentiful."
    ix. "The FSU BS in HVACR Engineering is the top program in it's field. I had

no problems getting a job of my choosing."

x. "Because of the very high job placement percentage upon graduation into good paying careers."
xi. "The HVAC program provided valuable knowledge: professors were very knowledgeable, and the job placement exceeds may other programs."
xii. "I would refer to other people because we are the best in the country."
xiii. "This is the best HVACR program in the country"
xiv. "I think that this is an exceptional program and the need for future prospects will only become greater in need."
xv. "I thought it was thorough and provided me with the information I needed to by successful."
xvi. "Even with the economy being bad, still employers are looking for HVAC graduates"
xvii. "because it provide numerous job opportunities after graduation."
xviii. "I have already recommended this program to other friends"
xix. "The program at Ferris helps to take the skills of a technically minded person and advance their thinking for both field / office in the HVACR career."
xx. "The HVAC industry offers many professions that can suit many types of people"
xxi. "I was employed in the HVAC field and had employees from FSU HVAC programs. I have sponsored scholarships and highly recommend both the AAS and BS programs."
xxii. "I would recommend it because it si top notch, I learned what I needed to and it got me a job."
xxiii. "The HVAC program was well-organized and committed to helping students. I would definitely recommend it."

D. Program Value

1. The benefits to the University by having these programs are many. Very few programs have given the University the high name recognition at the state, national and international level as the HVACR programs. From all the international competition wins, working with the EPA and certifying hundreds of thousands of HVACR technicians, receiving national acclaim for excellence of education in the industry and having a nationally recognized faculty (Note: one faculty member is a co-author of the main textbook used in our field), Ferris State University is a nationally and internationally recognized name in our field and a name that symbolizes quality and excellence. The A.A.S. program also prepares students to continue on to other 4 year programs offered at Ferris. Typically 30 - 40% of the 2 year graduates move on into the 4 year program creating further revenue and recognition to the University.
2. Ferris now has a state-of-the-art building for the students in HVACR to learn in. As a result of the last program review, the Granger Center has been built with the latest technology in not only the laboratory areas but also in the classrooms. The building was built with the intent that the building itself would be used as a training tool. All ductwork,

piping and equipment are exposed, labeled and color coded so they are readily available for use in instruction. There is no other facility in the nation that compares to the Granger Center for teaching HVACR.

3. Within the last year, the HVACR programs have a stable staff of professionals. Each faculty member in the HVACR program has years of experience in the field and experience in multiple areas of discipline. The students work with faculty members that are published authors, industry liaisons, industry review specialists, industry technical trainers, business owner and operators and active members of all the professional organizations in our field. The students not only receive quality education within the technical areas of the field but practical working and applied knowledge of the field. This enhances the student's ability to get quality jobs and also gives the potential employer an employee that is fully productive day one on the job. The graduate surveys have described over and over the value of being productive from the very first day to themselves and their employer.
4. The most valuable asset to the employer has already been stated, a quality employee that is productive from the first day on the job. Time is money and it is critical for employers that the graduates can carry a full work load with minimum supervision from the start. The amount of time it takes a typical Mechanical Engineering graduate to be productive is about 2 years of additional on the job training. Again, our graduates can produce from the start and is the key reason that the program has a 100% placement of all graduates at well paying salaries. Value to the employer is derived from feedback on surveys of employers, graduates and advisory board members. It also is displayed at the number of offers that each graduate gets and the number of return employers such as Trane, Carrier, Johnson Controls, Siemens, etc. that hire numerous graduates year after year.
5. The programs, faculty and facilities have benefited entities external to the university in many different ways. The faculty are all active in professional organization both in our field and related fields. The organizations include: Air Conditioning Contractors of America (ACCA), American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE), Mechanical Service Contractors of America (MSCA). Positions within these organization range from student advisors, regional vice presidents and document review panels members. The Ferris faculty are impacting the vary information that not only our students are using, but students from all other HVACR programs and current professionals are using. The facility is also being used by professional organizations and industry for meetings, seminars and training. The Granger Center has one of the only major HVACR control training labs in the state of Michigan.
6. Three of the programs provide service learning to the local and regional community. HVAC451 (Energy Audit) Course has had a component in it that the students must perform a full technical assistance energy audit on a real building. A majority of the buildings in the Big Rapids area have had full energy audits done free of change so that the students can get real life experience. This service learning has been going on in this class since it's start up in 1984. Local buildings included: Big Rapids City Hall, Mecosta county services building, Pioneer buildings, Big Rapids Furniture, Big Rapids Products, St. Peters Lutheran Church, the Methodist Church. Building in the region include: The Grand Rapids Public Museum, Alticor's research and development building, Alticor's distribution

center and the Frauenthal Theater in Muskegon, MI. HVAC342 (Load Calculation & Energy Modeling) also takes students into the field to perform studies on real local buildings. HVAC245 (Residential design) eposes the students to actual buildings in the field to learn the residential design process. All the owners of these businesses get valuable information for free. The students in these courses get valuable experience working on real structures and dealing with a real customer.

Section 2 – Collection of Perceptions

A. Graduate follow-up survey: The purpose of this activity is to learn from the graduates their perceptions and experiences regarding employment based on program outcomes. The goal is to assess the effectiveness of the program in terms of job placement and preparedness of the graduate for the marketplace. A mailed or e-mailed questionnaire is most preferred; however, under certain conditions telephone or personal interviews can be used to gather the data. (see appendix 3 for survey, appendix 4 for frequencies from AAS alumni and appendix 5 for frequencies from BS alumni)
   a. AAS HVACR GRADUATE FINDINGS:
      i. Is there an industry need to increase the number of students?
         1. 38 of 43 respondents felt the industry needed an increased number of students
      ii. When you attended, were the class sizes to large (number of students per faculty)?
         1. 43 of 45 respondents felt class sizes were not too large when they attended school.
      iii. When was the last time you visited the HVAC building?
         1. No meaningful data emerged, as respondents reported a wide range of time since their last visit.
      iv. Initial Salary Range:
         1. This question sought initial salary range from graduates. Of 48 respondents, 19 indicated an initial salary below $20,000; 13 started at between $20,000 and $25,000; two were in the 25,000 to $30,000; another two were in the 30,000 to $35,000 range, and six were in each of the ranges from $35,000 to $40,000 and $40,000 to $45,000. Two thirds (66.7%) began their careers with an associate degree at a salary below $25,000.
         2. It is important to note that of 48 respondents, only four reported graduating in the past 10 years, 75% reported graduating before 1994, 48% graduated before 1981, and 25% reported graduating before 1973. Since inflationary calculations were not employed, the findings of this survey question are not valid.
      v. Current Salary Range:
         1. Nearly 80% of respondents earn more than $50,000. Unlike the data from “initial salary,” this information has validity since no inflationary factors are present. 34 (71%) of respondents reported earning over $60,000, while 8%

(4) earn between $50,000 and $60,000. The remaining six respondents were divided into groups of two, with one group in the $40,000 to $45,000 range, another in the $35,000 to $40,000 range, and the lowest group earning below $25,000.

vi. Career Avenue Which Most Closely Describes Your Daily Activities

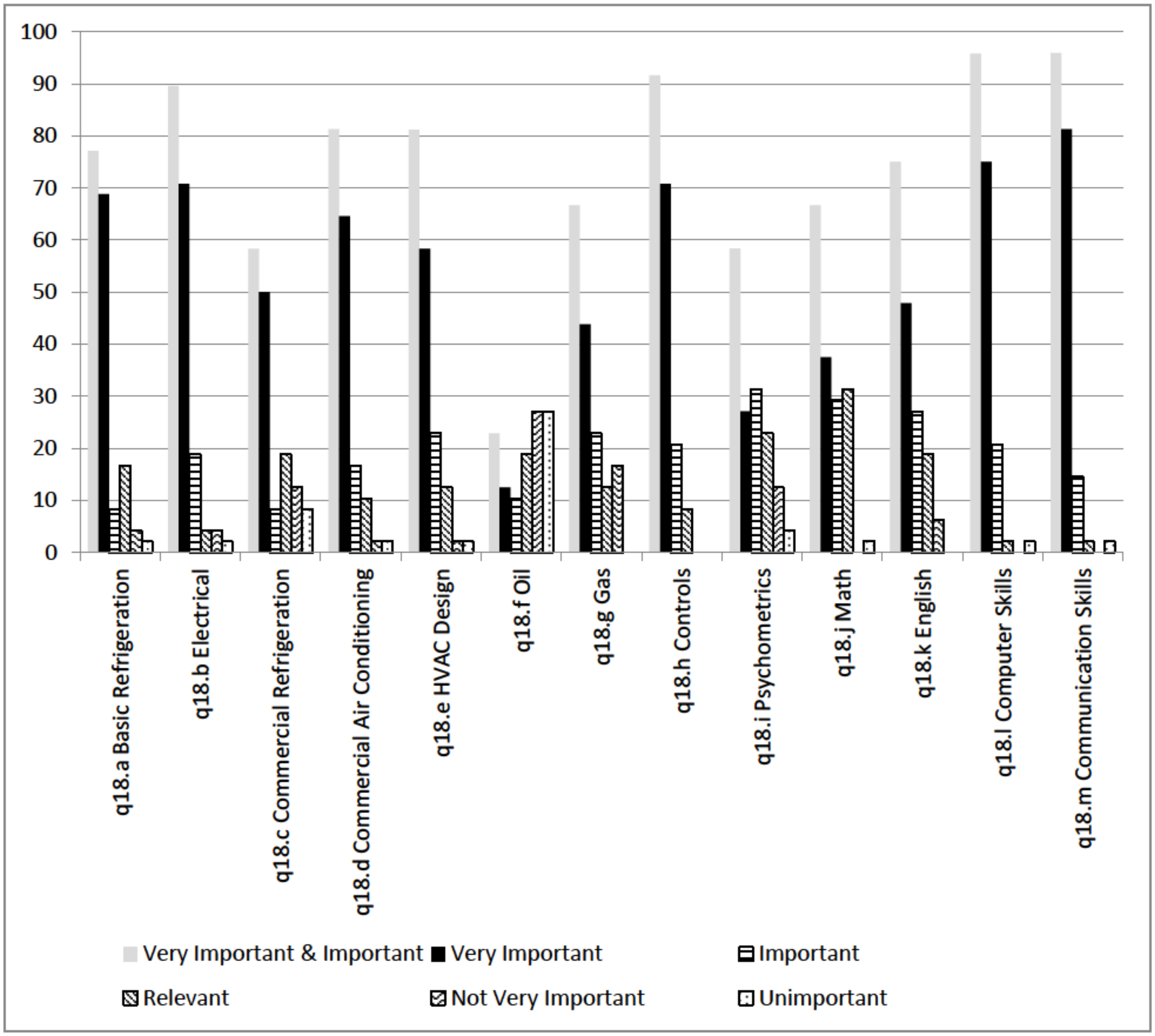
1. The largest group of respondents (15 of 45) reported that they were in company management or ownership. This would be a significant finding if the respondents stopped at the associate degree. However, with 12 of 48 respondents indicated they had earned the HVAC BS and four more reporting they had earned a business degree beyond their associate degree, the significance of this finding is somewhat, but not totally diminished.
2. No other large group emerged from this data. The next largest group (n=8) indicated their daily activities were "other" than the choices offered in the survey.
3. **Question F** provided a space for respondents to describe what "other" meant if that was what they checked as a career avenue. While the responses are varied, five of the 13 responses include the words "management, leader, director, or vice president." There is some overlap between in the data, since only eight respondents reported "other" as their career avenue, while 13 defined what "other" meant. That is a discrepancy of five, and it is possible that the five "extra" respondents who defined "other" were some of the same respondents who reported being in management or ownership of a company. At best, it can only be deduced that 15 of 45 respondents are in management or ownership. None-the-less, 33% is a significant percentage in management positions coming from a group of graduates who began their educational careers modestly with an associate degree.

vii. Scientific and Technical topics for Your Career:

1. Rate the relevance of the topic to your career using, 5 = Very important, 4 = Important, 3 = Relevant, 2 = Not Very Important, 1 = Unimportant
2. The table below summarizes the responses and includes a column with the sum of "very important" and "important."
3. The data is difficult to analyze from the perspective of relevance to AAS graduates exclusively, since 12 of the 48 respondents reported earning the BS in HVACR from Ferris, with another seven reporting earning a degree in addition to the AAS in HVACR. Further, only six of the 48 respondents described their job as directly related to the AAS degree, using job titles such as Service Engineer, Service Tech, service man, and senior lab technician.
4. For the technical core, respondents rated Oil significantly lower (13% very important, 10.4% important) than all other subjects. Commercial Refrigeration (50% very important, 8.3% important) and Psychrometrics (27% very important, 31% important) were next. These are not surprising

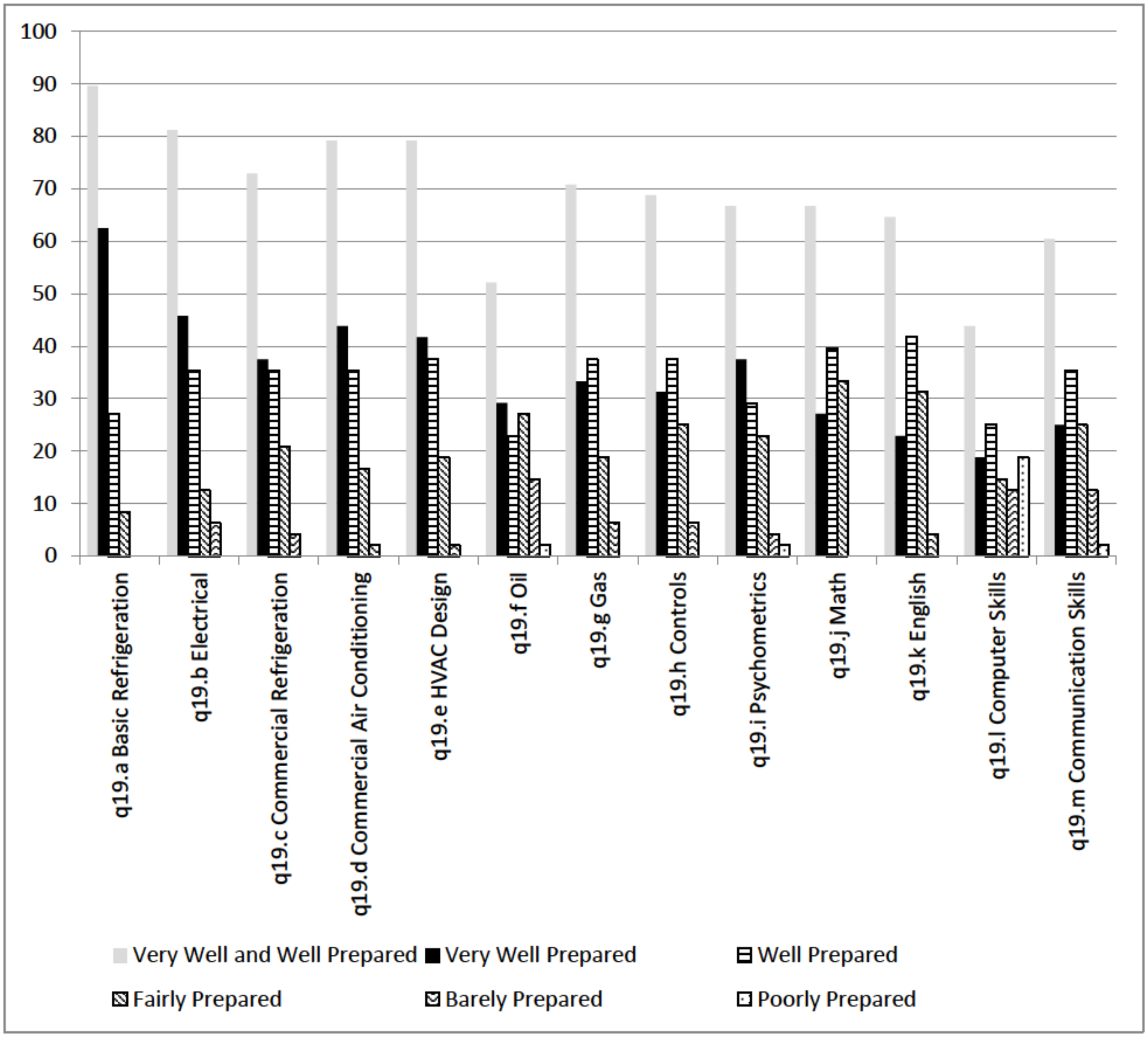
numbers, as each subject is a specialty niche within the HVACR industry. Technicians specialize in both commercial refrigeration and oil, and while commercial refrigeration is a large segment of the industry, heating with oil has significantly reduced in the market. Psychrometrics is foundational theory, but is typically used only by designers in the field.

5. Of significance is the relatively low rating of Math (a combined 67% very important and important), since mathematical skills are required in virtually every sector of the industry. Of interest are the extremely high ratings of both Computer Skills and Communication Skills (both had combined ratings of 96% very important and important).



viii. Scientific and Technical topics for Your Career:

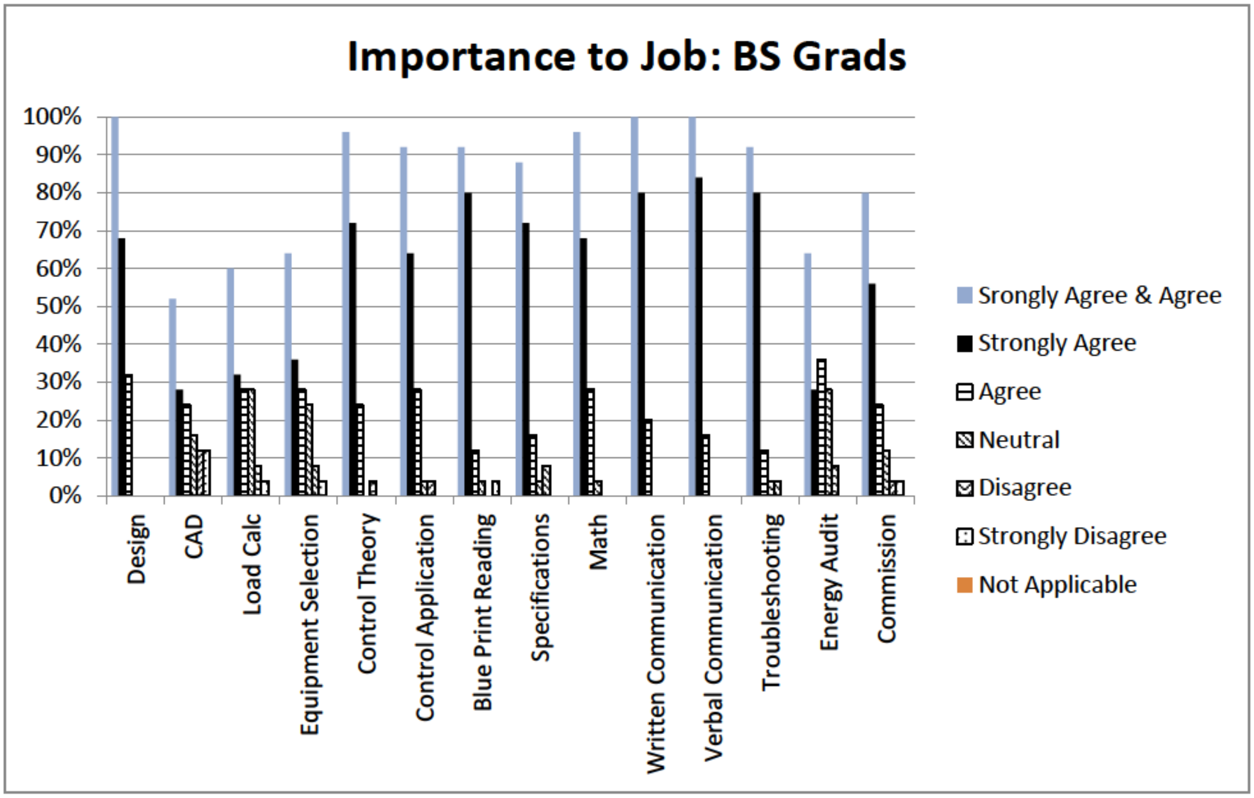
1. Rate the preparation that you received from your HVACR program using, 5 = Very Well Prepared, 4 = Well Prepared, 3 = Fairly Prepared, 2 = Barely Prepared, 1 = Poorly Prepared.
2. The table below summarizes the responses and includes a column with the sum of “very well prepared” and “well prepared.”
3. These findings seem to indicate that much learning occurs in the real world following education at Ferris. This reinforces the general feeling of the faculty that students do not discover what are lacking in terms of knowledge and skill until they become employed in the industry. One respondent reinforced this fact with the comment, “The real learning starts after graduation.”
4. In general, it appears the respondents felt they were either very well or well prepared for technical subjects in general, though they indicated a somewhat lower level of preparedness for the general education subjects listed in the survey.
5. Oil once again ranked lowest. Of interest are the relatively low rankings of computer skills and communication skills. While respondents felt these subjects were very important or important, they did not indicate that they were well prepared.



ix. The five parts of **Question H** deal with Course Content and Mix

1. Does the program need more technical content?
    a. The findings reported in the table above are corroborated by the response to this question. 71% of respondents indicated "yes."
2. Does the program need more social awareness courses?
    a. 69% did **not** see the need for more social awareness content.
3. Does the program need more cultural enrichment courses?
    a. 75% did **not** see the need for more cultural enrichment content.
4. Does the program need more communication courses?
    a. 67% felt the need for more communication skills.
5. Does the program need more writing intensive courses?
    a. The respondents were evenly split over the need for more writing intensive courses.

b. BS HVACR GRADUATE FINDINGS:
   i. Is there an industry need to increase the number of students?
      1. 100% of respondents who answered this question (22 of 25) felt the industry needed an increased number of students.
   ii. Should the number of faculty per students be increased?
      1. 17 of 21 respondents felt the number of faculty per student should be increased.
   iii. When was the last time you visited the HVAC building?
      1. No meaningful data emerged, as respondents reported a wide range of time since their last visit.
   iv. Initial Salary Range:
      1. This question sought initial salary range from graduates. Of 25 respondents, the highest percentage (32%) reported starting at more than $50,000. 24% started at between $40,000 and $45,000, while 16% started between $45,000 and $50,000 and another 16% started between $35,000 and 40,000.
   v. Current Salary Range:
      1. 60% of respondents (15 of 25) earn more than $70,000, while 16% are in the $60,000 to $70,000 range. 24% earn less than $60,000.
   vi. Career Avenue Which Most Closely Describes Your Daily Activities
      1. The responses to this question and the follow up question which provides a space to define “other” as a career avenue are widely varied. Careers involving controls and energy have the largest grouping of graduates, though those career avenues do not have high enough numbers to be significant.
      2. The data indicates that graduates find careers in a wide spectrum of HVACR opportunities. This seems to indicate the strength of a diversified curriculum that does not cater to or specialize in any one specific sector.
      3. Graduates were asked to rank several aspects of the BS curriculum. The table below includes summary data related to the importance of these aspects to their job. More than 50% of respondents “strongly agreed” or “agreed” that each aspect was important to their job. Like the AAS grads, the BS grads ranked communication skills extremely high, with 100% ranking these skills in the “strongly agree” or “agree” category. Math ranked higher for this group of graduates than for the AAS graduates. This is likely because BS graduates tend to find work in the professional sectors of the industry, though many of the AAS respondents also reported working in these sectors. Sectors that ranked low indicate that these areas are not that important to the specific jobs held by the respondents.

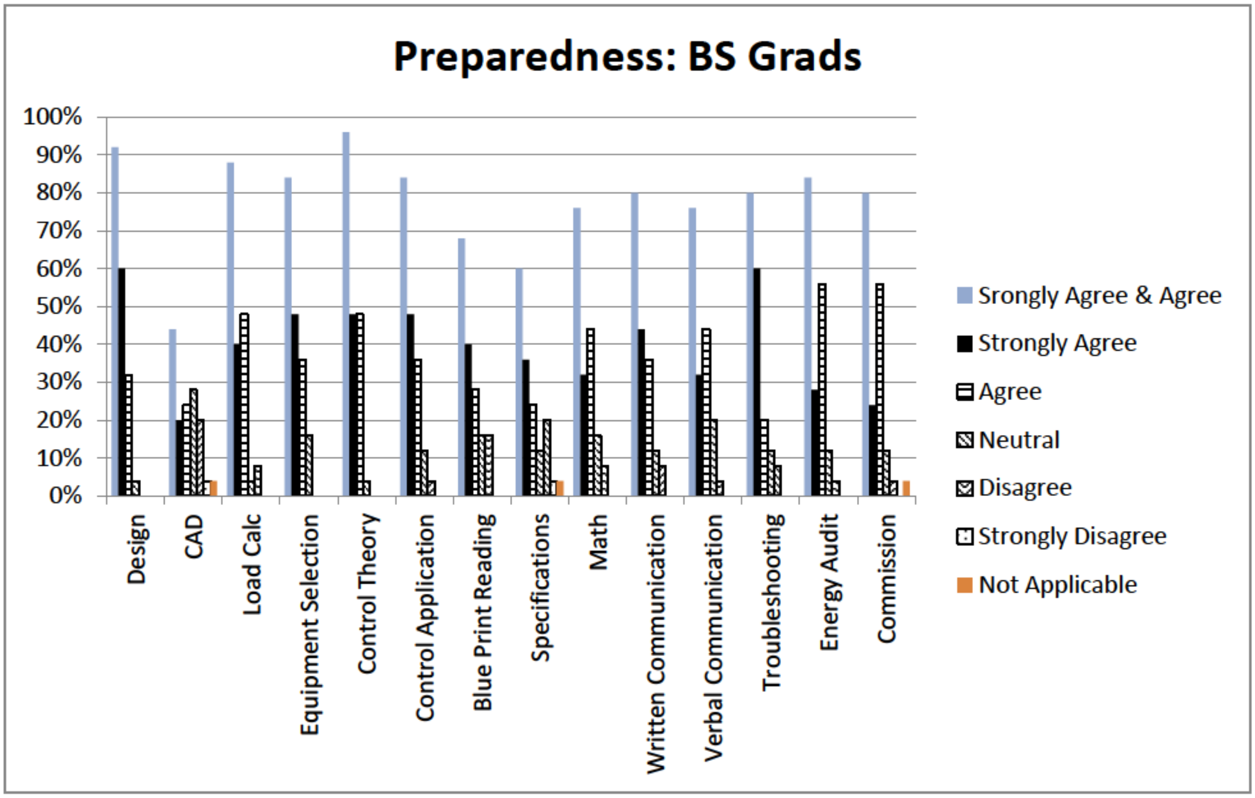


vii. The next table summarizes respondents perception of their preparedness in the same areas discussed above. This table represents significant findings, as in all categories other than CAD, 60% or more of respondents "strongly agreed" or "agreed" that they were well prepared for these areas. This indicates quality and strength of the BS curriculum. Of note are the two areas (Blue Print Reading and Specifications) that are ranked relatively lower than other areas (other than CAD). Without a specific print and specification reading course, this is not a surprising finding. This is an area that could use improvement within the time constraints of the curriculum.

1. Additionally, 96% of respondents "strongly agreed" or "agreed" that they were well prepared for the job they are doing. One respondent was neutral. 84% felt that advising was adequate in the HVAC program, though placement services did not fare so well. 48% strongly agreed or, though placement services did not fare so well. Only 48% "strongly agreed" or "agreed" that placement services were adequate, while 28% were neutral and 24% disagreed.
2. Even in the economy of this APR cycle, 92% of respondents reported having no problem finding a job after graduation, with only one respondent feeling "neutral" about this point. Of all respondents, 100% either "strongly agreed" (52%) or "agreed" (48%) that they were able to be productive on the job right out of school.
3. 88% believe there is a high demand for the HVACR 4-year graduate, while

two felt neutral about this point.

4. Only 20% of respondents "strongly agreed" that the mix of technical/social & cultural courses were adequate. 60% "agreed," while 16% were neutral and 4% disagreed.



viii. The five parts of **Question H** deal with Course Content and Mix.

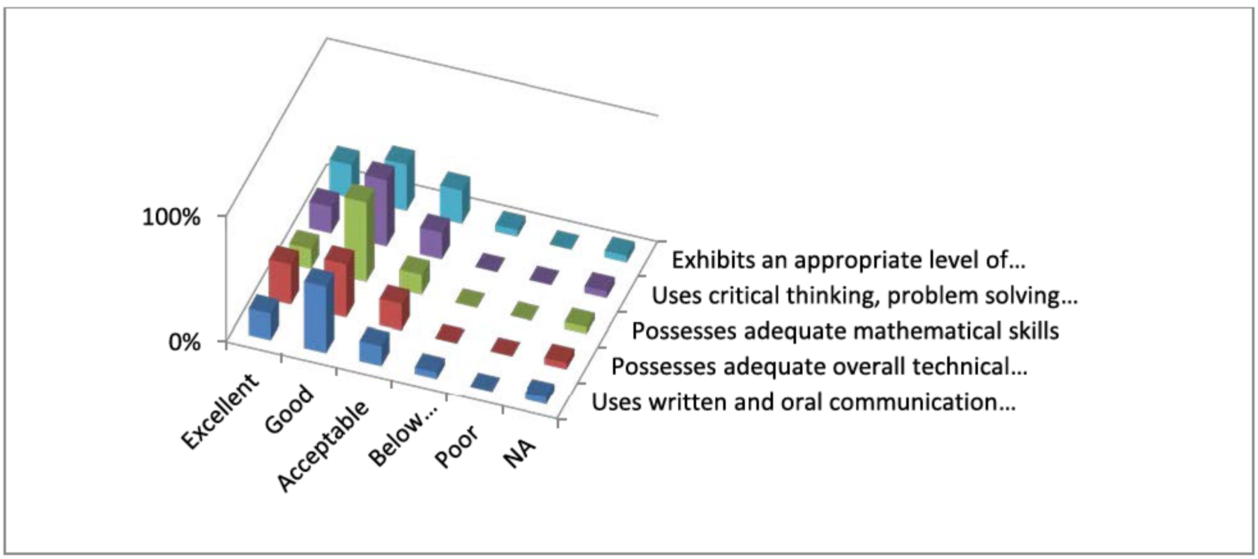
1. Does the program need more technical content?
    a. The findings reported in the table above are corroborated by the response to this question. 71% of respondents indicated "yes."
2. Does the program need more social awareness courses?
    a. 69% did **not** see the need for more social awareness content.
3. Does the program need more cultural enrichment courses?
    a. 75% did **not** see the need for more cultural enrichment content.
4. Does the program need more communication courses?
    a. 67% felt the need for more communication skills.
5. Does the program need more writing intensive courses?
    a. The respondents were evenly split over the need for more writing intensive courses.

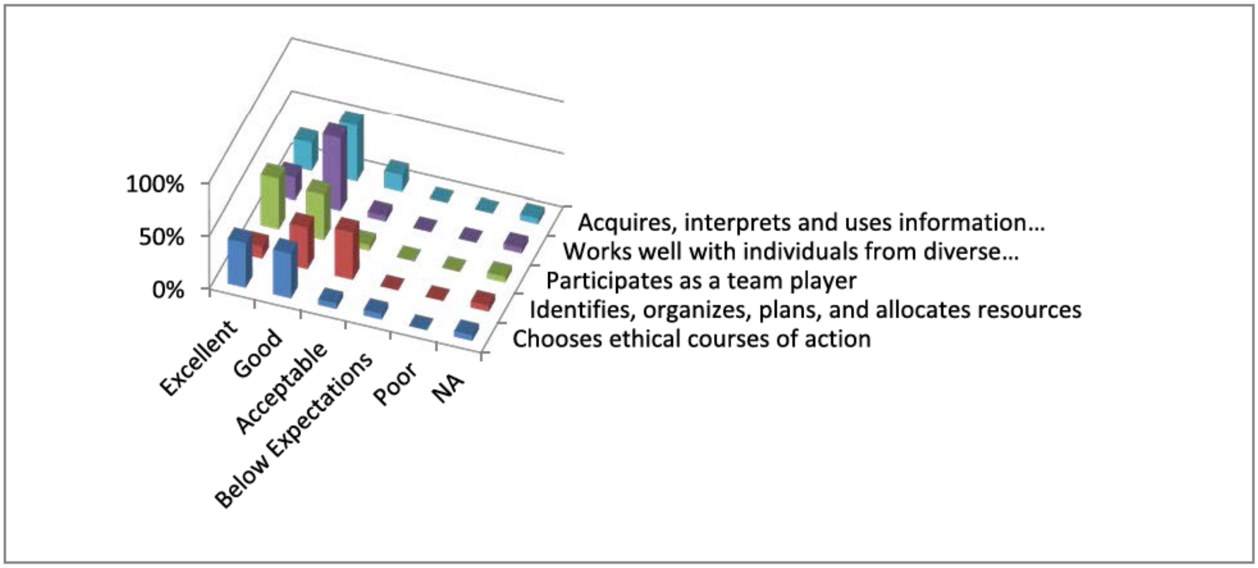
B. Employer follow-up survey: This activity is intended to aid in assessing the employers' experiences with graduates and their perceptions of the program itself. A mailed or e-mailed instrument should be used to conduct the survey; however, if justified, telephone or personal interviews may be used to gather the data. The chart below indicates the frequencies. (see appendix 6 for survey)

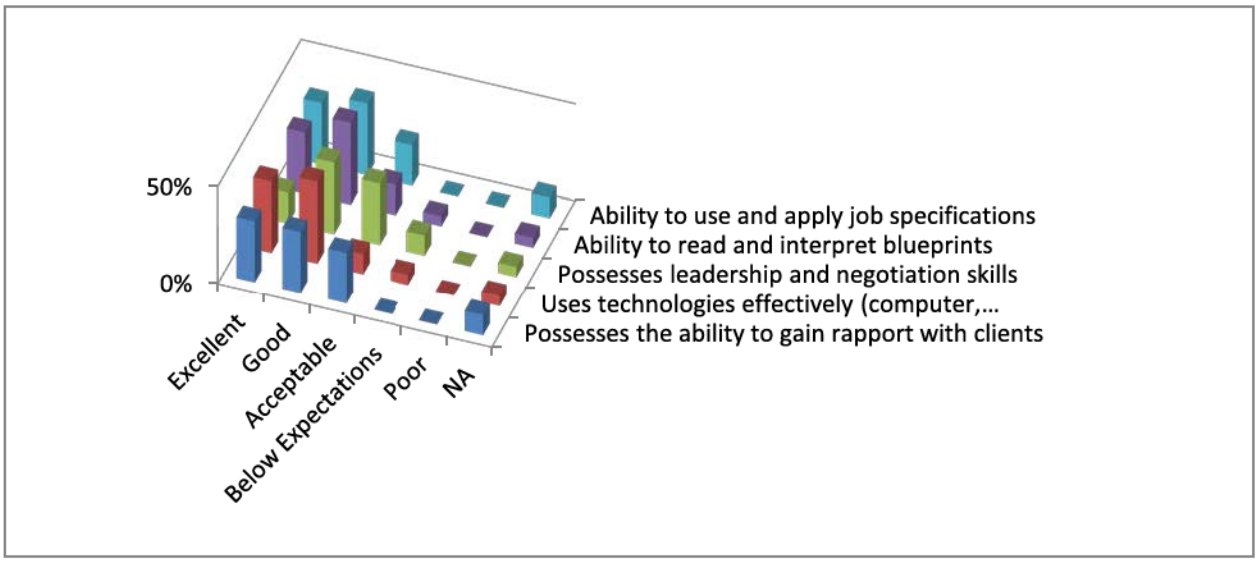
HVACR APR...Employer Frequencies														
	Frequency							Percent						
	Excellent	Good	Acceptable	Below Expectations	Poor	NA	Total	Excellent	Good	Acceptable	Below Expectations	Poor	NA	Cumulative Percent
Uses written and oral communication skills effectively	4	10	3	1	0	1	19	21	53	16	5	0	5	100
Possesses adequate overall technical skills in HVACR	6	8	4	0	0	1	19	32	42	21	0	0	5	100
Possesses adequate mathematical skills	3	12	3	0	0	1	19	16	63	16	0	0	5	100
Uses critical thinking, problem solving and decision making skills	4	10	4	0	0	1	19	21	53	21	0	0	5	100
Exhibits an appropriate level of responsibility and self management	5	7	5	1	0	1	19	26	37	26	5	0	5	100
Chooses ethical courses of action	8	8	1	1	0	1	19	42	42	5	5	0	5	100
Identifies, organizes, plans, and allocates resources	2	7	8	0	0	1	18	11	39	44	0	0	6	100
Participates as a team player	9	8	1	0	0	1	19	47	42	5	0	0	5	100
Works well with individuals from diverse backgrounds	4	13	1	0	0	1	19	21	68	5	0	0	5	100
Acquires, interprets and uses information effectively	5	10	3	0	0	1	19	26	53	16	0	0	5	100
Possesses the ability to gain rapport with clients	6	6	5	0	0	2	19	32	32	26	0	0	11	100
Uses technologies effectively (computer, telecommunications, etc)	7	8	2	1	0	1	19	37	42	11	5	0	5	100
Possesses leadership and negotiation skills	3	7	6	2	0	1	19	16	37	32	11	0	5	100
Ability to read and interpret blueprints	6	8	3	1	0	1	19	32	42	16	5	0	5	100
Ability to use and apply job specifications	6	7	4	0	0	2	19	32	37	21	0	0	11	100
Recognize and understand all HVACR systems	4	8	4	2	0	1	19	21	42	21	11	0	5	100
Knowledge of control theory and terminology	7	4	6	1	0	1	19	37	21	32	5	0	5	100
Understand and develop electrical and control schematics	3	7	5	1	0	3	19	16	37	26	5	0	16	100
Ability to troubleshoot a single simple HVACR system	7	3	5	0	0	4	19	37	16	26	0	0	21	100
Ability to troubleshoot a complex or multiple HVACR systems	4	3	3	5	0	4	19	21	16	16	26	0	21	100
Understand HVACR safety sequences	5	4	5	1	0	4	19	26	21	26	5	0	21	100
Ability to work on CAD	0	5	6	0	1	7	19	0	26	32	0	5	37	100
Ability to develop an HVACR bid	3	3	7	0	0	6	19	16	16	37	0	0	32	100
Ability to commission an HVACR system after install or repair	0	5	3	2	0	9	19	0	26	16	11	0	47	100
Ability to install HVACR components or systems	0	2	5	1	0	11	19	0	11	26	5	0	58	100
Understands the importance of time management	3	6	9	0	0	1	19	16	32	47	0	0	5	100
Completes a job with minimal re-work	2	8	5	2	0	2	19	11	42	26	11	0	11	100
Understands HVACR codes, standards and regulations	1	7	3	4	0	4	19	5	37	16	21	0	21	100

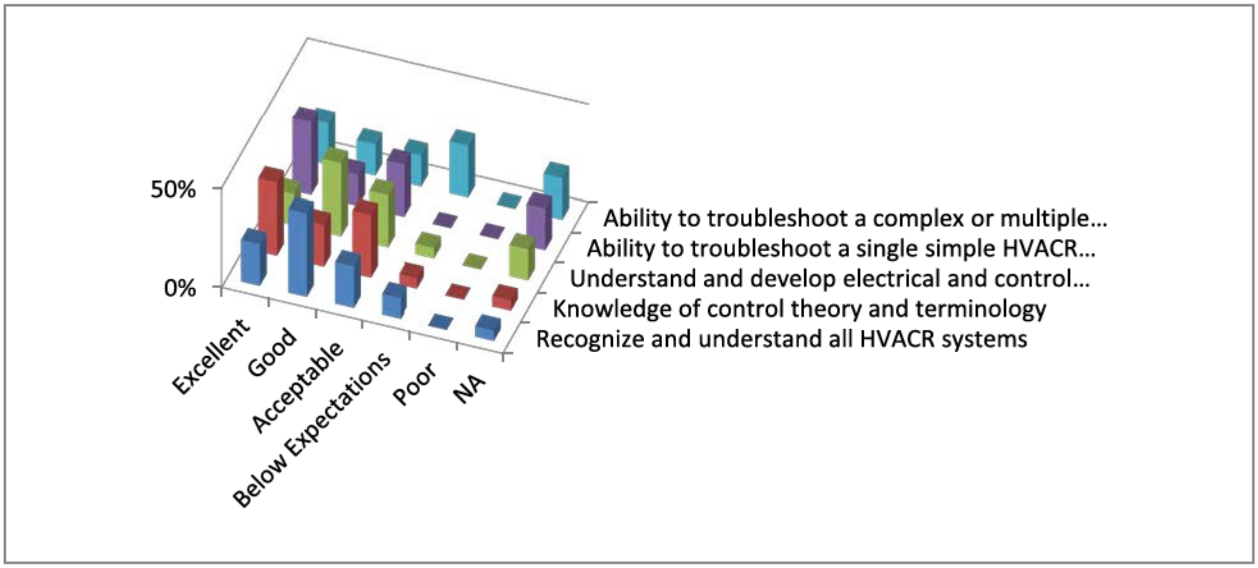
a. The data is presented in several charts below. For the most part, employers found graduates to be "excellent," "good," or "acceptable" in the categories studied in this review. Only one (Ability to work on CAD) received a "poor" rating. However, a number of areas were rated as "below expectations." Those areas are tabulated below. Many include higher-order skills that can only come with experience. For example, 26% of respondents reported that graduates were below expectations for "Ability to troubleshoot a complex or multiple HVACR systems." This is skill that takes years to develop. However, 21% of respondents reported that graduates were below expectations in their ability to understand HVACR codes, standards and regulations. This is area that warrants faculty attention. (Note, those skills with 5% represent only one respondent.)

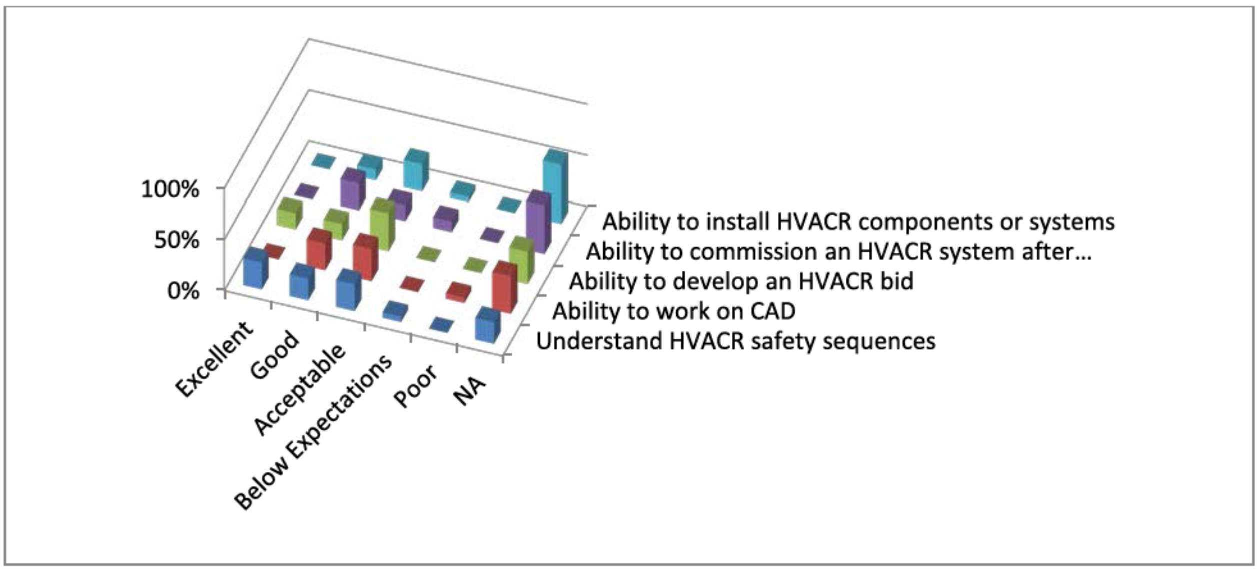
   i. Ability to troubleshoot a complex or multiple HVACR systems....................26%
   ii. Understands HVACR codes, standards and regulations............................... 21%
   iii. Possesses leadership and negotiation skills 11%
   iv. Recognize and understand all HVACR systems ... .11%
   v. Ability to commission an HVACR system after install or repair....................11%
   vi. Completes a job with minimal re-work 11%
   vii. Uses written and oral communication skills effectively.................................5%
   viii. Exhibits an appropriate level of responsibility and self management...........5%
   ix. Chooses ethical courses of action 5%
   x. Uses technologies effectively (computer, telecommunications, etc)............5%
   xi. Ability to read and interpret blueprints 5%
   xii. Knowledge of control theory and terminology 5%
   xiii. Understand and develop electrical and control schematics..........................5%
   xiv. Understand HVACR safety sequences 5%
   xv. Ability to install HVACR components or systems 5%

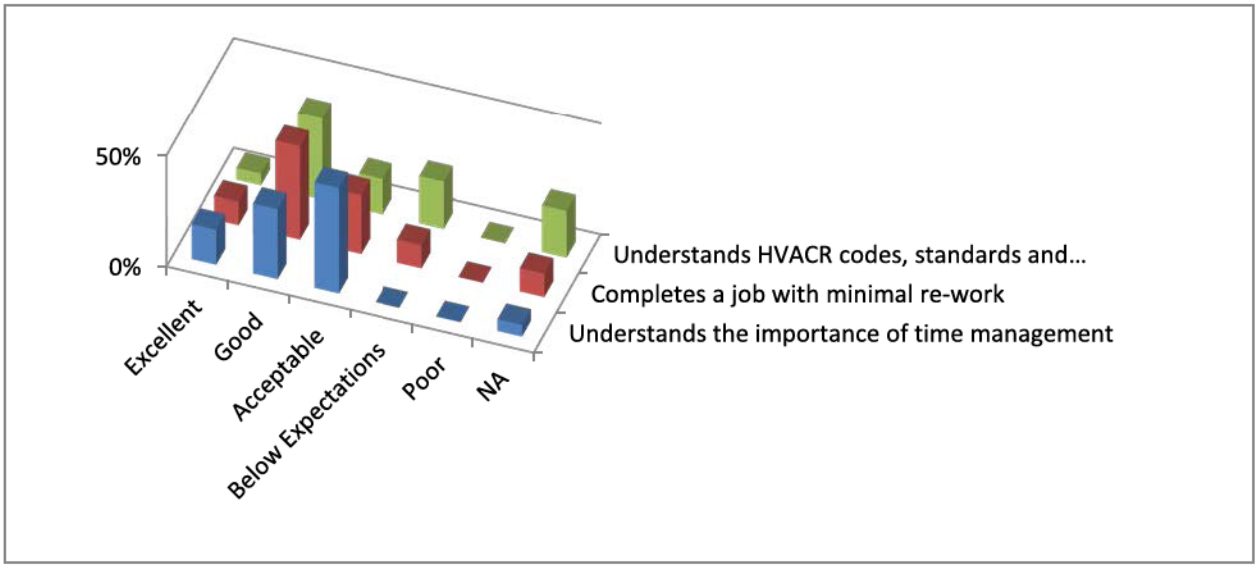



100%
50%
0%
Excellent
Good
Acceptable
Below Expectations
Poor
NA
Acquires, interprets and uses information…
Works well with individuals from diverse…
Participates as a team player
Identifies, organizes, plans, and allocates resources
Chooses ethical courses of action


50%
0%
Excellent
Good
Acceptable
Below Expectations
Poor
NA
Ability to use and apply job specifications
Ability to read and interpret blueprints
Possesses leadership and negotiation skills
Uses technologies effectively (computer,…
Possesses the ability to gain rapport with clients


50%
0%
Excellent
Good
Acceptable
Below Expectations
Poor
NA
Ability to troubleshoot a complex or multiple...
Ability to troubleshoot a single simple HVACR...
Understand and develop electrical and control...
Knowledge of control theory and terminology
Recognize and understand all HVACR systems


100%
50%
0%
Excellent
Good
Acceptable
Below Expectations
Poor
NA
Ability to install HVACR components or systems
Ability to commission an HVACR system after...
Ability to develop an HVACR bid
Ability to work on CAD
Understand HVACR safety sequences



b. The data provide in the charts above indicate an overall satisfaction with the level of graduates entering the industry. Comments from employers in general agree with this finding. Some specific and individual needs are found in the comments, such as BIM. One respondent indicated that written communication abilities is marginal, and this seems to back up the comments of the graduates themselves, who indicate the need for more communication coursework.

c. Areas for improvement emerged from the employer data and provide good fodder for faculty discussion. Overall, employers displayed an overwhelming satisfaction with the skills and knowledge of the Ferris graduates.

C. Graduating student exit survey:

a. Graduating students are surveyed every year on an ongoing basis to obtain information regarding quality of instruction, relevance of courses, and satisfaction with program outcomes based on their own expectations. The survey must seek student suggestions on ways to improve the effectiveness of the program and to enhance the fulfillment of their expectations. This survey is strongly suggested by HVAC faculty for graduating students to participate.

   i. Appendix 7 illustrates the results (frequencies) of the 2011 survey for the HVAC graduates from the AAS program. Since there was only one student who participated, the results are not indicative of any substantial outcome.

   ii. Appendix 8 illustrates the results (frequencies) of the 2012 survey for the HVAC graduates from the AAS program. Since there were only two students who participated, the results are not indicative of any substantial outcome.

   iii. Appendix 9 illustrates the results (frequencies) of the 2011 survey for the HVAC graduates from the BS program. Since there were only six students who participated, the results are not indicative of any substantial outcome.

   iv. Appendix 9 illustrates the results (frequencies) of the 2012 survey for the HVAC graduates from the BS program. Since there were only six students who participated, the results are not indicative of any substantial outcome.

v. It should be noted that seniors graduating in the BS program in 2012 were pushed to participate in the “Current Student Survey” for the APR and this data is illustrated in the next section (D).

D. Student Program Evaluation:

a. Current students are surveyed to obtain information regarding quality of instruction, relevance of courses, and satisfaction with program outcomes based on their own expectations. The survey must seek student suggestions on ways to improve the effectiveness of the program and to enhance the fulfillment of their expectations. This survey should be conducted during the year before the PRP report is submitted. The following is the frequencies from the survey. (see appendix 11 for survey)

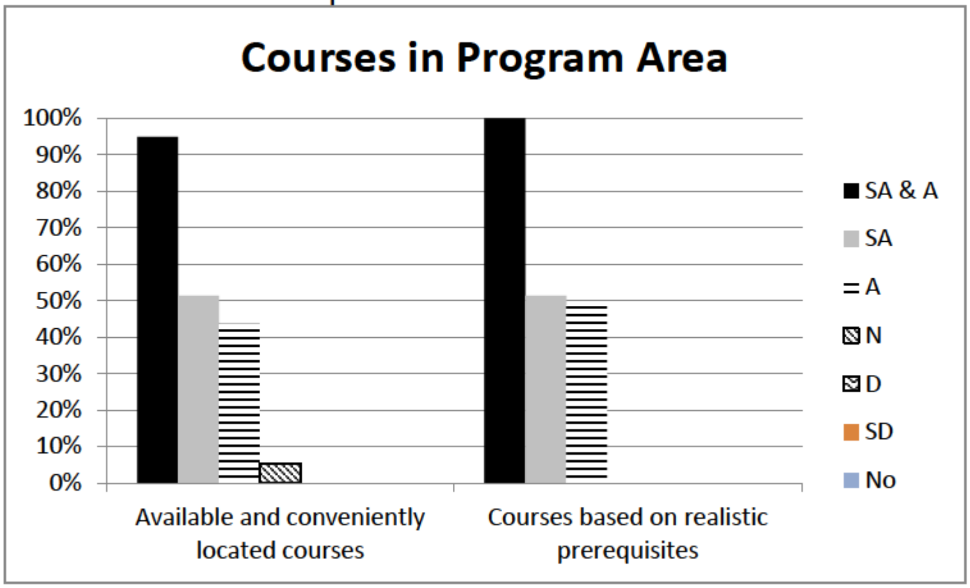
HVACR APR...Current Student Frequencies										
	Available and conveniently located courses	Courses based on realistic prerequisites	Available written course objectives	Descriptive course objectives	Course objectives used by faculty	teaching meets needs, interests & objectives	teaching provide supervised practice	Program faculty know subject matter	Program faculty are available	Program faculty are interesting and understandable
Frequency										
SA	20	20	22	21	13	15	14	25	17	13
A	17	19	16	18	21	20	22	13	17	23
N	2	0	0	0	3	4	2	0	4	3
D	0	0	1	0	2	0	1	0	1	0
SD	0	0	0	0	0	0	0	0	0	0
No	0	0	0	0	0	0	0	1	0	0
Percent										
SA	51	51	56	54	33	38	36	64	44	33
A	44	49	41	46	54	51	56	33	44	59
N	5	0	0	0	8	10	5	0	10	8
D	0	0	3	0	5	0	3	0	3	0
SD	0	0	0	0	0	0	0	0	0	0
No	0	0	0	0	0	0	0	3	0	0
	100	100	100	100	100	100	100	100	100	100

HVACR APR...Current Student Frequencies										
	Related course faculty know subject matter	Related course faculty are available	Related course faculty are interesting and understandable	Adequate lighting & ventilation in computer labs	Enough computer work stations	Safe, functional, well maintained computer labs	Equally available computer lags	Adequate lighting and ventilation on HVAC labs	enough work stations in HVAC labs	Safe, functional and well maintained HVAC labs
Frequency										
SA	14	11	11	11	15	11	16	11	13	11
A	22	22	25	16	13	15	17	13	13	14
N	1	6	3	6	8	5	4	8	7	4
D	2	0	0	5	2	3	1	1	0	3
SD	0	0	0	0	0	5	0	2	2	4
No	0	0	0	1	1	0	1	4	4	3
Percent										
SA	36	28	28	28	38	28	41	28	33	28
A	56	56	64	41	33	38	44	33	33	36
N	3	15	8	15	21	13	10	21	18	10
D	5	0	0	13	5	8	3	3	0	8
SD	0	0	0	0	0	13	0	5	5	10
No	0	0	0	3	3	0	3	10	10	8
	100	100	100	100	100	100	100	100	100	100

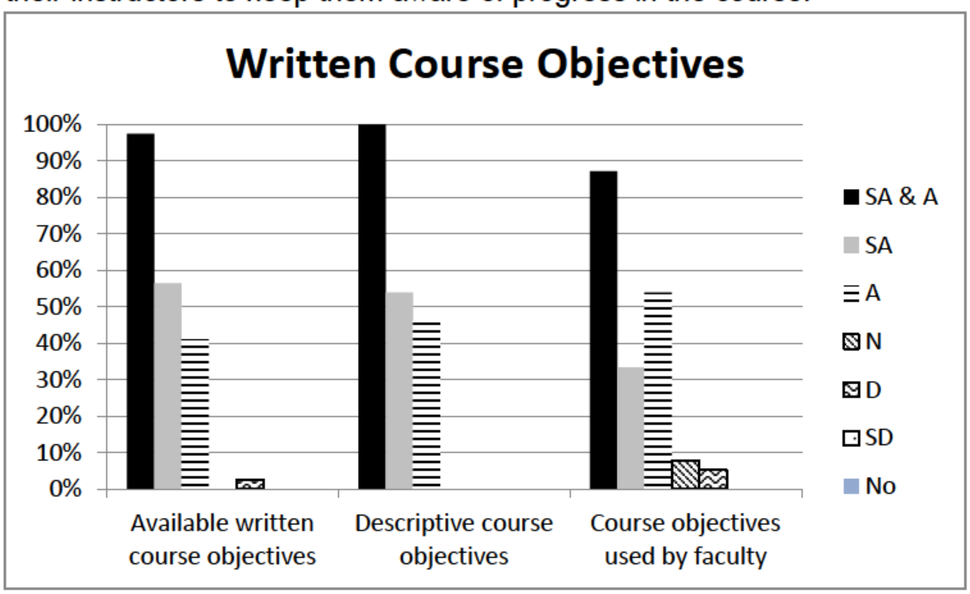
HVACR APR...Current Student Frequencies										
	Equally available HVAC labs	Current instructional equipment	Sufficient quantity of instructional equipment	Safe and good condition instructional equipment	Current and meaningful instructional materials	Available and convenient instructional materials	Available tutoring	Tutoring provided by knowledgeable and interested staff	Helpful placement services	Placement services prepared for job
Frequency										
SA	13	17	11	12	19	14	6	6	20	20
A	15	18	22	20	19	24	16	16	12	12
N	6	2	3	4	1	1	11	11	2	3
D	1	0	2	1	0	0	0	0	2	1
SD	1	1	0	1	0	0	0	0	0	0
No	3	1	1	1	0	0	6	6	3	3
Percent										
SA	33	44	28	31	49	36	15	15	51	51
A	38	46	56	51	49	62	41	41	31	31
N	15	5	8	10	3	3	28	28	5	8
D	3	0	5	3	0	0	0	0	5	3
SD	3	3	0	3	0	0	0	0	0	0
No	8	3	3	3	0	0	15	15	8	8
	100	100	100	100	100	100	100	100	100	100

b. 39 students responded to a survey for this section of the APR. Due to the number of questions in the student survey, the data have been broken into several charts according to the categories in the survey. Again, the “Strongly Agree” and “Agree” responses have been combined into a new column in each chart to help identify the magnitude of positive responses.

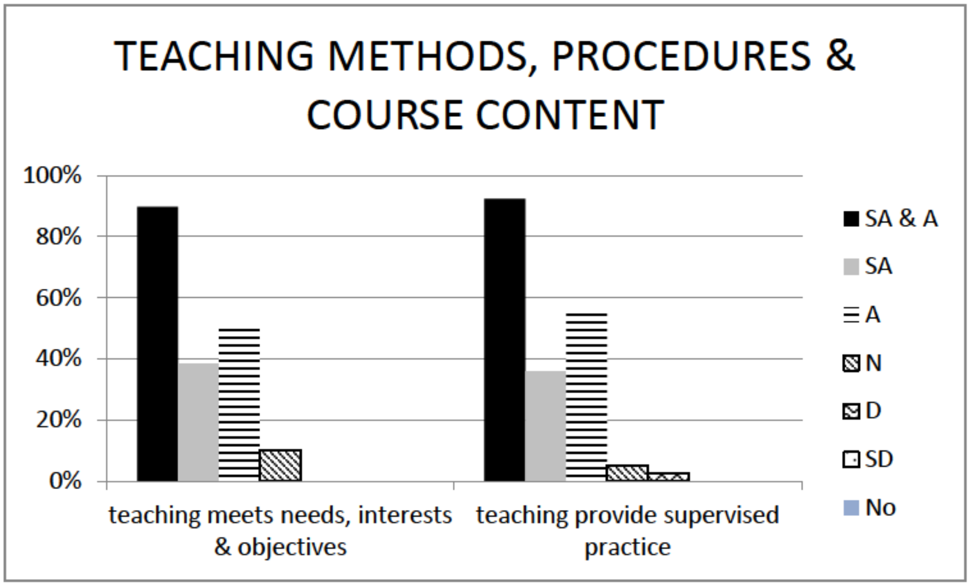
c. In response to two questions relative to courses in the program area, nearly all of the students agreed or strongly agreed that the courses were available, conveniently located, and based on realistic expectations.



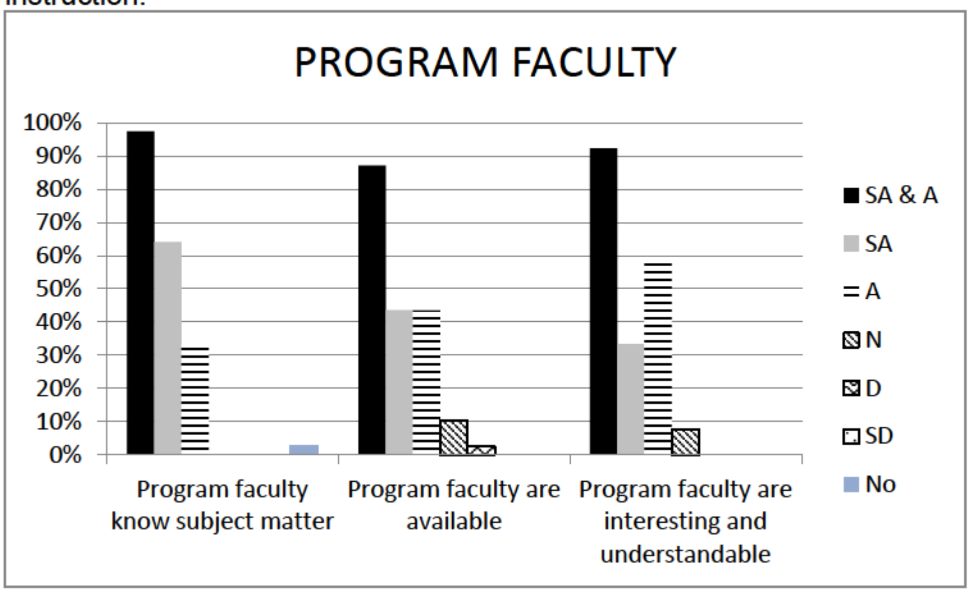
d. Students also mostly strongly agreed or agreed that written objectives for program courses were available, described what they would learn in the course, and were used by their instructors to keep them aware of progress in the course.



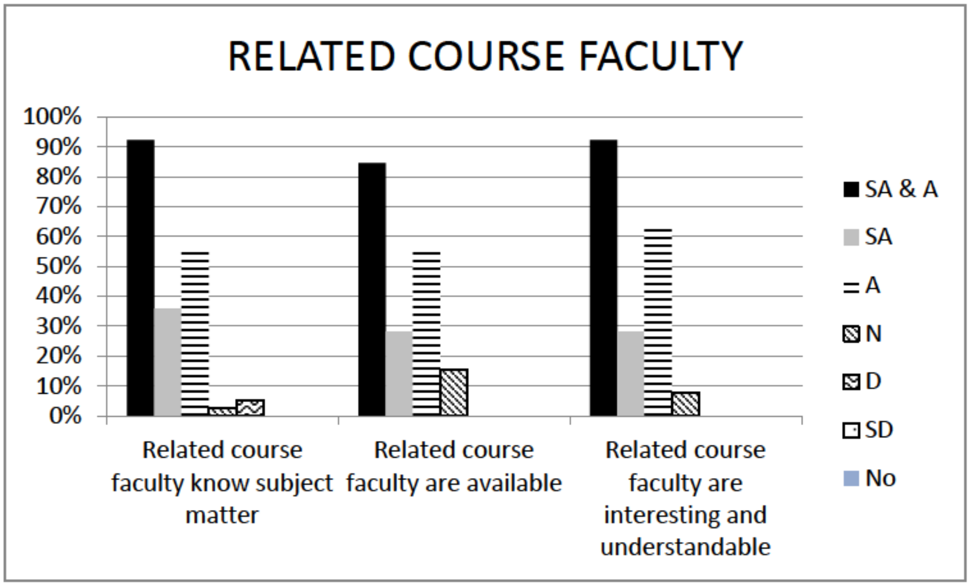
e. Students were similarly positive about teaching methods, procedures and course content. They felt the methods, procedures and course content met their projected career needs, interest and objectives, and provided supervised practice for their skill development.



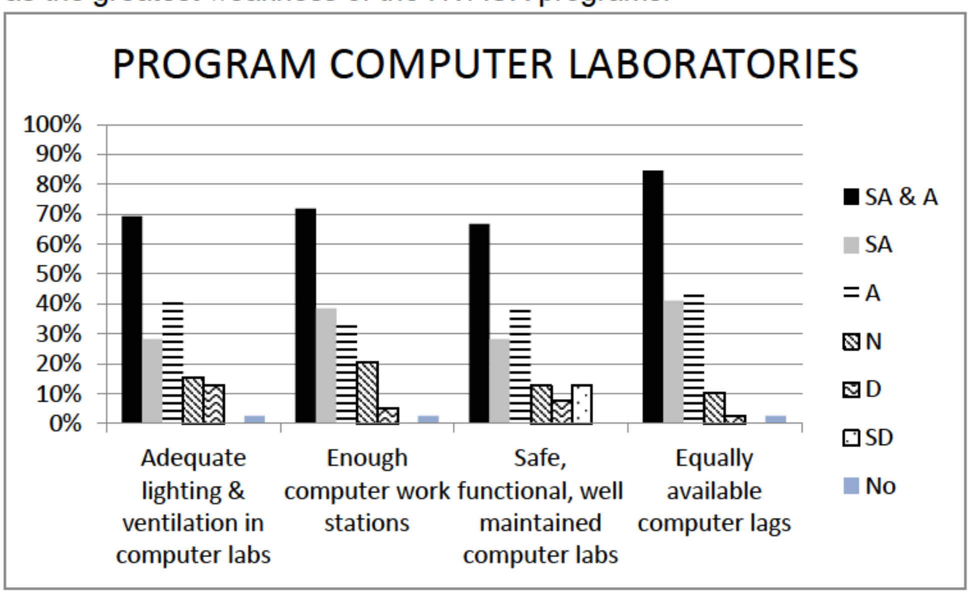
f. Students felt that program faculty knew subject matter and occupational requirements were available to help when needed, and provided interesting and understandable instruction.



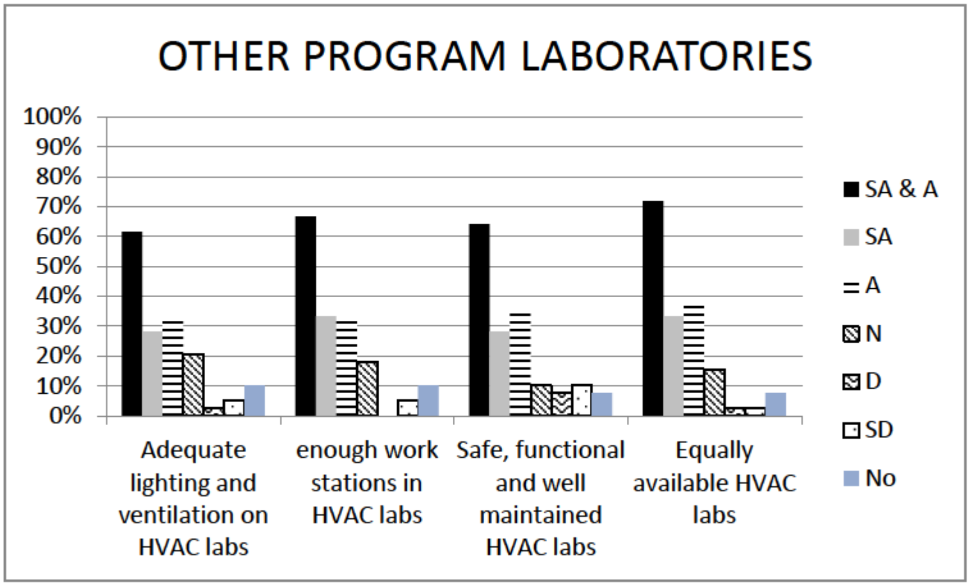
g. Students reported similar perceptions of related course faculty in the same areas of subject matter, occupational requirements, availability for help, and interesting and understandable instruction.



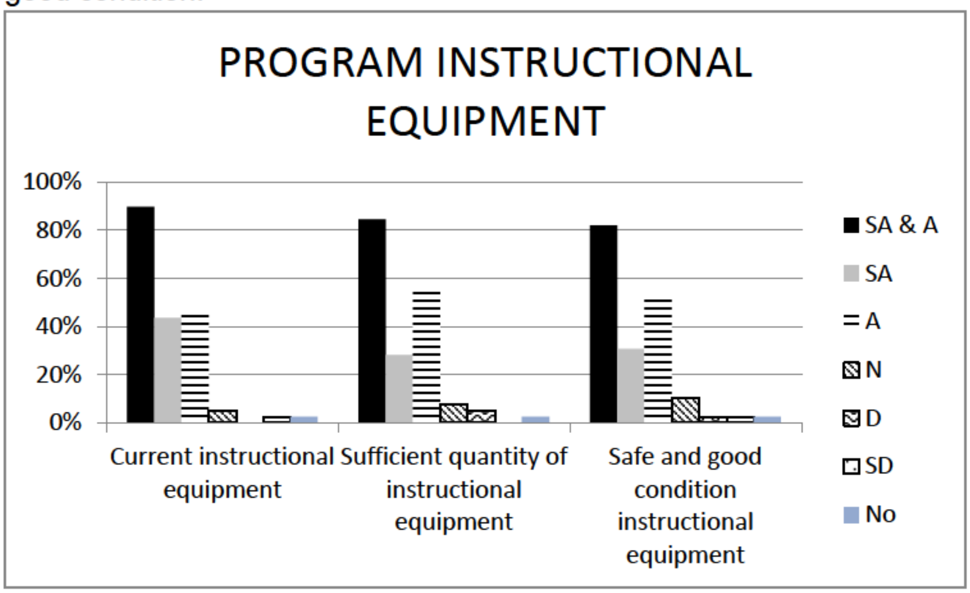
h. Students did not feel as positive about the quality of the computer laboratory facilities. Though more than 50% of respondents strongly agreed or agreed with statements about adequate lighting, ventilation, number of work stations, and the safety, functionality, and maintenance of the labs, nearly a quarter of students did not think the labs were adequately maintained. A review of comments will find nine that cite the computers labs as the greatest weakness of the HVACR programs.



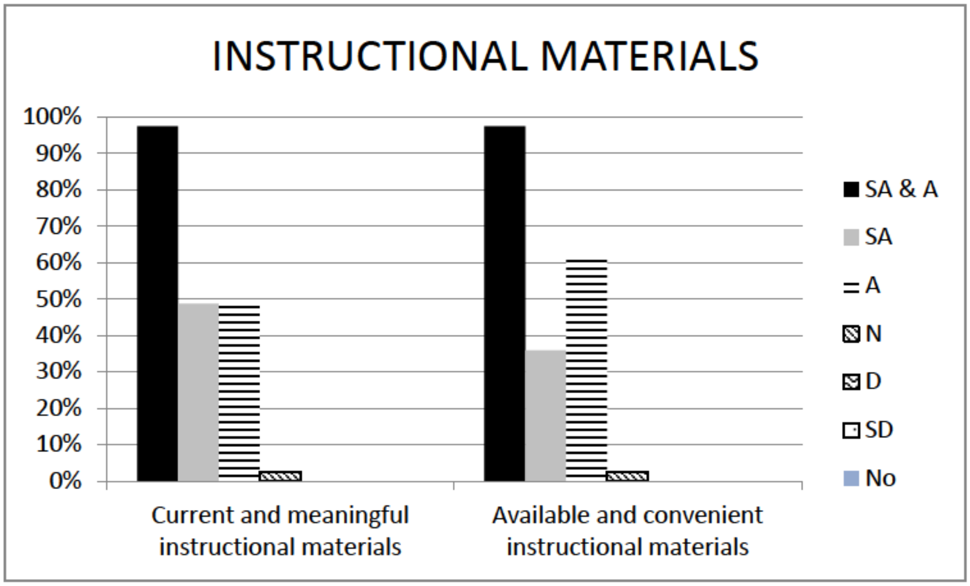
i. A similar level of dissatisfaction was found in the respondent's perception of other program laboratories. Though some disagreed that both the computer labs and other labs were equally available, the survey did not provide the opportunity to find out why the students felt that way, or what they meant by "equally available."



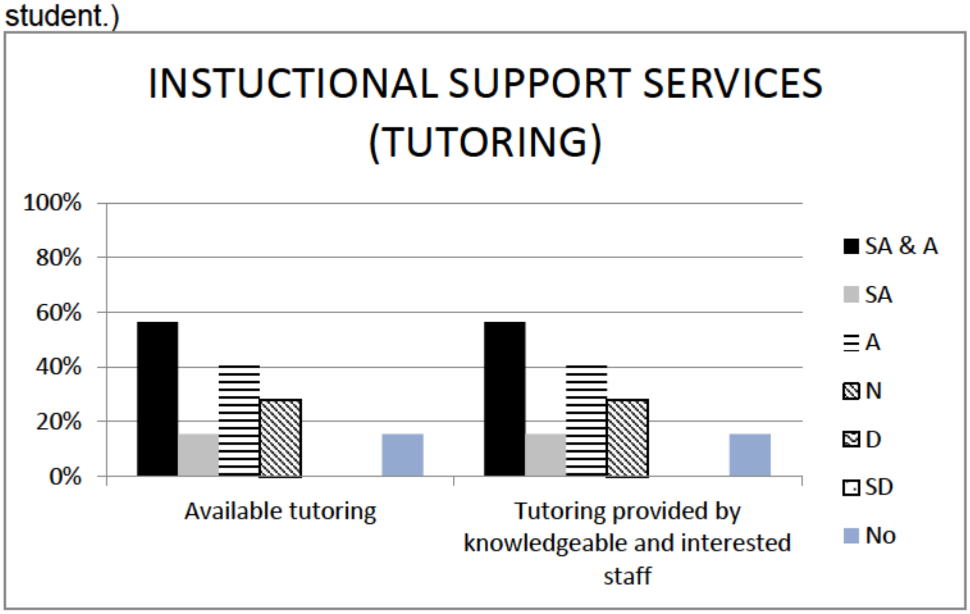
j. Overall, students felt the program's instructional equipment was current and represented that found in industry. They also perceived there to be a sufficient quantity of equipment so as to avoid long delays in use, and they considered the equipment to be in save and good condition.



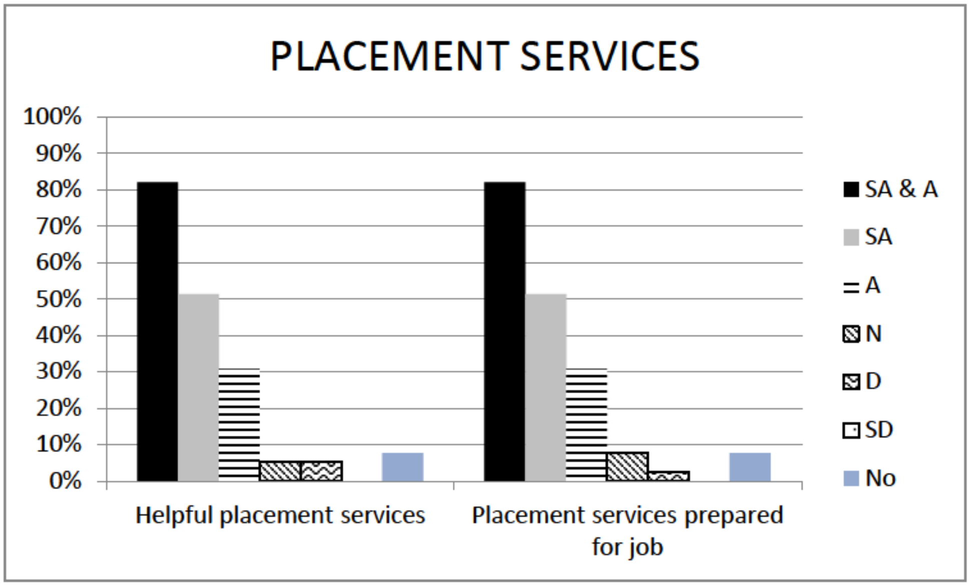
k. Students felt particularly positive about the instructional materials, with nearly 100% reporting them to be current, meaningful, available, and conveniently located.



l. Instructional services (tutoring) received the most negative responses in the student survey. Although over 50% agreed or strongly agreed that tutoring was available to meet their needs and interests, and was provide by knowledgeable and interested staff, nearly a third (28%) of respondents disagreed with those statements. (15% had no opinion, perhaps because they did not take advantage of or require tutoring while they were a student.)



m. Placement services received relatively high marks from respondents, with over 80% either agreeing or strongly agreeing that these services helped prepare them for a job and find employment opportunities.



E. Faculty perceptions:

a. The purpose of this activity is to assess faculty perceptions regarding the following aspects of the program: curriculum, resources, admissions standards, degree of commitment by the administration, processes and procedures used, and their overall feelings. Additional items that may be unique to the program can be incorporated in this survey. Five of nine faculty responded to the survey. The first section of the survey asked faculty to rank various elements as "strongly agree," "agree," "neutral," "disagree," "strongly disagree," or "no response." Strongly agree is rated as a "6," while strongly disagree rates as a "1." The average findings are listed below and sorted in order of agreement with the statements to disagreement. (see appendix 12 for survey)

b. 1. The Granger Center facilities are adequate...5.4
c. 15. The HVACR Dept. has enough visibility in the HVACR industry................5.4
d. 2. The student advisory loads are reasonable...5
e. 11. Travel funds are sufficient. 5
f. 4. The HVACR Dept. is well represented on the promotion committee. 4.8
g. 7. Course assignments are appropriate..4.6
h. 9. Faculty teaching loads are appropriate. 4.6
i. 12. Representation in professional societies by faculty is appropriate..........4.6
j. 5. The HVACR curriculum review process is effective. 4.4
k. 8. Course assignments are equitable...4.4
l. 10. Course textbook approval policy is appropriate.....................................4.4
m. 3. The HVACR Dept. is well represented on the CET Curriculum Committee. 4.2
n. 6. There are sufficient meeting times for the HVACR faculty.........................4
o. 16. The HVACR Dept. advisory board does an effective job..........................4
p. 14. The HVACR Dept. receives a proper share of CET resources....................3.8
q. 13. The Chair has done an effective job. 2.2

Strong Agreement
Neutral
Strong Disagreement

r. Averages between 5 and 6 indicate agreement to strong agreement with the statement, with a stronger agreement indicated by a value closer to 6. Those between 4 and 5 indicate a response between neutral and agreement, with a value closer to 5 indicating stronger agreement. Only two responses fall below neutral. Faculty are nearly neutral (3.8) in response to the share of CET resources received by the HVAC department. In the statement “The chair has done an effective job,” the average response of 2.2 indicates disagreement to strong disagreement. It should be noted that the HVACR department really does not have a chair under the current College of Engineering Technology structure as the lead faculty is now a “coordinator” with 1/3 of the release time from when this position was a true “chair” position. The following is the frequencies from the faculty survey.

HVACR APR...Faculty Frequencies																
	Granger Center Adequate	Reasonable Advising Loads	Well Represented: Curriculum Committee	Well Represented, Promotion Committee	Effective Curriculum Review	Sufficient Meeting Times	Appropriate Course Assignments	Equitable Course Assignments	Appropriate Teaching Load	Appropriate Text Approval	Sufficient Travel Funds	Appropriate Representation in Professional Societies	Effective Job by Chair	Proper Share of CET Resources	Enough Visibility in HVACR Industry	Effective Advisory Board
Frequencies																
SA	2	1	0	0	0	1	1	1	1	1	1	2	0	0	2	0
A	3	3	2	4	2	1	2	2	2	3	3	2	0	1	3	2
N	0	1	2	1	3	1	1	1	1	0	1	0	0	3	0	1
D	0	0	1	0	0	1	1	0	1	0	0	0	2	0	0	2
SA	0	0	0	0	0	1	0	1	0	0	0	0	2	1	0	0
NR	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0
Percent																
SA	40	20	0	0	0	20	20	20	20	20	20	40	0	0	40	0
A	60	60	40	80	40	20	40	40	40	60	60	40	0	20	60	40
N	0	20	40	20	60	20	20	20	20	0	20	0	0	60	0	20
D	0	0	20	0	0	20	20	0	20	0	0	0	40	0	0	40
SA	0	0	0	0	0	20	0	20	0	0	0	0	40	20	0	0
NR	0	0	0	0	0	0	0	0	0	20	0	20	20	0	0	0
Cumulative Percent																
	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

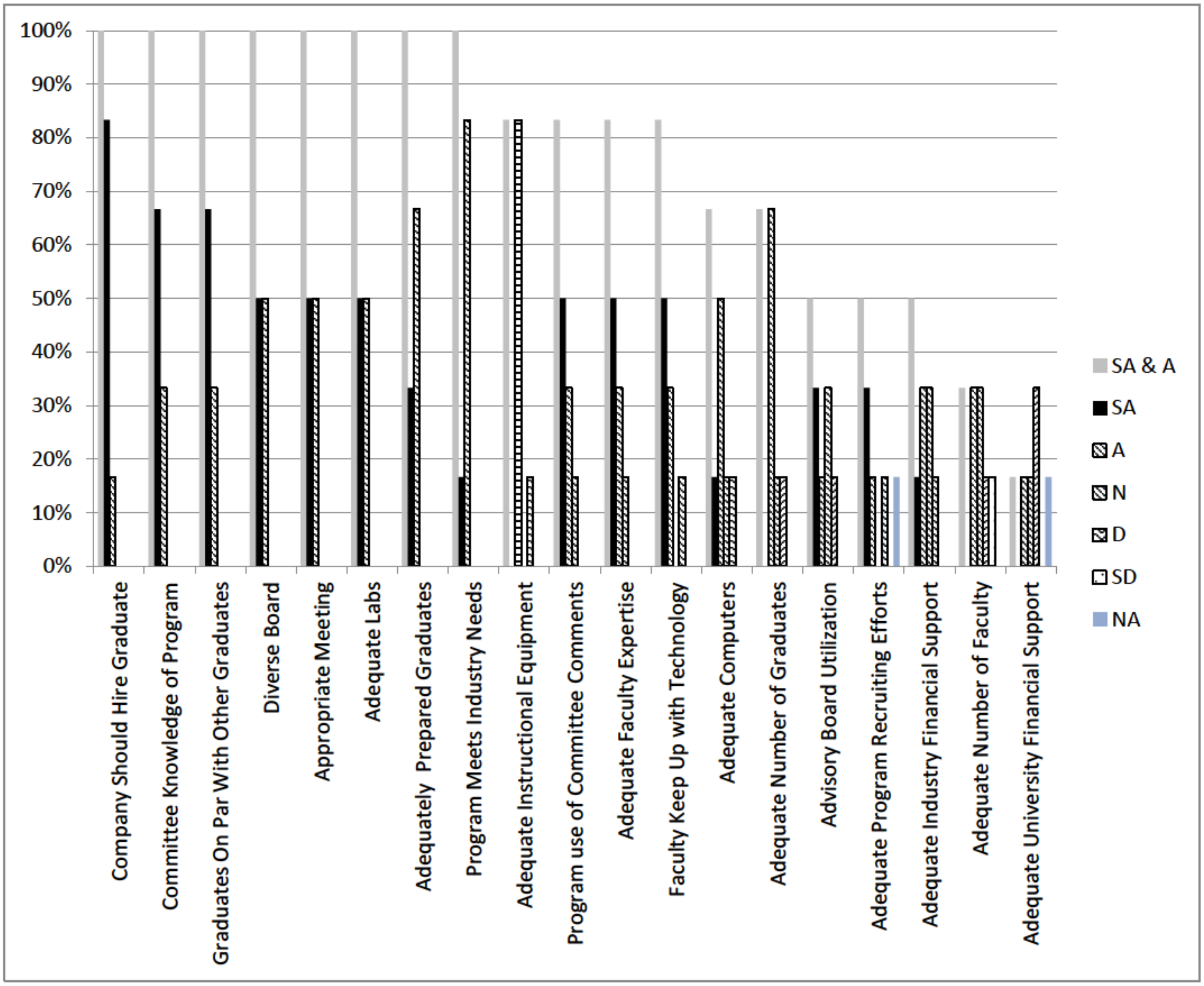
F. Advisory committee perceptions:

a. The purpose of this survey is to obtain information from the members of the program advisory committee regarding the curriculum, outcomes, facilities, equipment, graduates, micro- and megatrends that might affect job placement (both positively and adversely), and other relevant information. Recommendations for improvement must be sought from this group. In the event that a program does not have an advisory committee, a group of individuals may be identified to serve in that capacity on a temporary basis. The following is the frequencies for this survey. (see appendix 13 for survey)

HVAC APR...Advisory Board Frequencies

	Diverse Board	Appropriate Meeting	Advisory Board Utilization	Committee Knowledge of Program	Program use of Committee Comments	Adequate Labs	Adequate Computers	Adequate University Financial Support	Adequate Industry Financial Support	Adequately Prepared Graduates	Program Meets Industry Needs	Adequate Number of Graduates	Adequate Number of Faculty	Adequate Faculty Expertise	Company Should Hire Graduate	Faculty Keep Up with Technology	Adequate Instructional Equipment	Graduates On Par With Other Graduates	Adequate Program Recruiting Efforts
Frequency																			
SA & A	6	6	3	6	5	6	4	1	3	6	6	4	2	5	6	5	5	6	3
SA	3	3	2	4	3	3	1	0	1	2	1	0	0	3	5	3	0	4	2
A	3	3	1	2	2	3	3	1	2	4	5	4	2	2	1	2	5	2	1
N	0	0	2	0	1	0	1	1	2	0	0	1	2	1	0	0	0	0	0
D	0	0	1	0	0	0	1	2	1	0	0	1	1	0	0	1	1	0	1
SD	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
NA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Percent																			
SA & A	1	100	50	100	83	100	67	17	50	100	100	67	33	83	100	83	83	100	50
SA	0.5	50	33	67	50	50	17	0	17	33	17	0	0	50	83	50	0	67	33
A	0.5	50	17	33	33	50	50	17	33	67	83	67	33	33	17	33	83	33	17
N	0	0	33	0	17	0	17	17	33	0	0	17	33	17	0	0	0	0	0
D	0	0	17	0	0	0	17	33	17	0	0	17	17	0	0	17	17	0	17
SD	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0
NA	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	17
Cumulative Percent																			
	1	100	100	100	100	100	100	67	100	100	100	100	100	100	100	100	100	100	67

b. The table below illustrates the perceptions of the six advisory board members who responded to the survey. The table includes a sum of "Strongly Agree" and "Agree" responses and is sorted from left to right, first by the sum of "Strongly Agree" and "Agree", and then by "Strongly Agree." The sort was completed in order of most agreement to least agreement.



c. Board members felt that they had adequate knowledge of the program to carry out their duties, and they felt the board was made of members who represented a diverse cross section of the industry. They were also in agreement on the frequency of the meetings (2x/year). Most significantly, from the perspective of program relevance, board members were in 100% agreement on the points of the preparedness of graduates. They felt the program adequately prepared graduates for the industry, and also felt that graduates were on par with graduates from other universities with similar program. Though not implicitly stated, for the four-year graduates, the comparison is most often made to mechanical engineering graduates from other universities, since there is only one other similar program (Pennsylvania College of Technology).

d. Just over 80% of respondents agreed that the program had the equipment it needed to adequately teach the subject material/ None strongly agreed and the remainder were neutral about the issue. 83% of respondents felt that faculty had adequate expertise and kept up with technology. Of these, 50% strongly agreed, another 33% agreed and the remainder were neutral. The perception of faculty use of board members recommendations and comments fell along the exact same distribution. On a similar topic, only 50% of respondents either strongly agreed or agreed that they were adequately utilized by faculty. A third were neutral about this issue and 17% disagreed with the statement. Though almost 70% of faculty agreed the facility had adequate computers, none strongly agreed, and 17% felt neutral while another 17% disagreed with the statement.
e. No respondents strongly agreed with the statement that there were enough graduates for the industry, though 67% agreed that there was. 17% felt neutral and the remaining 17% disagreed with the statement.
f. The lowest agreement amount advisory board respondents was found in four statements involving resources. None strongly agreed with the statements regarding an adequate number of faculty or adequate university financial support, and only 33% agreed with the former while even less (17%) agreed with the latter. A third were neutral about the number of faculty, while 17% disagreed that there were enough and another 17% strongly disagreed. Regarding university financial support, 17% of respondents were neutral about the issue, while a third disagreed that there was adequate support. 17% responded with "NA," presumably because they did not have adequate information to make a determination.
g. The members were divided over the statement about adequate industry financial support. While 17% percent strongly agreed that the support was adequate and 33% agreed, another 33% were neutral and 17% disagreed.
h. Finally, only 50% of respondents felt the program expended adequate recruiting efforts (33% strongly agreed, 17% agreed). 17% were neutral about the recruiting statement and another 17% responded with "NA."
i. Overall, it appears that the advisory board respondents feel that the program is strong academically in preparing students for careers in the HVACR industry. At the same time, the respondents felt less strongly about the expertise and current industry knowledge of faculty. The least amount of positive feelings from this group of respondents involved issues of resources, including computers, financial support, and number of faculty.

G. Additional Studies: Two faculty have completed research related to HVACR student achievement during this APR cycle. Brian Holton authored a thesis paper and Mike Feutz authored a dissertation. Chapter 5 of each paper is reproduced below, as each are germane to the topic of academic program review.

THE PHENOMENOLOGY OF THE BACHELOR OF SCIENCE
IN HVAC ENGINEERING TECHNOLOGY
FROM FERRIS STATE UNIVERSITY

Michael Feutz, Ph.D.
Western Michigan University, 2010

Career and Technical Education (CTE) has evolved from industry-specific training to a more broad-based education that incorporates core academic learning objectives and prepares the student for work (Rothwell & Gerity, 2008; Uloa, 2006; Reese, 2002; Rojewski, 2002; Stone, 2002; Schmidli, 2001). Little is known about how well individual programs align with the industry for which graduates are prepared, (Zinser, 2003) or what CTE has meant to its graduates.

This research focused on graduates of the Bachelor of Science in Heating, Ventilation and Air Conditioning Engineering Technology (HVAC-ET) at Ferris State University in Big Rapids, Michigan. A phenomenological design was used to view the HVAC-ET program from the perspective of both campus and distance learning (online) graduates. Ten campus graduates and eight online graduates were interviewed to determine (a) what the HVAC-ET program meant to them on a personal level; (b) how they perceived they were prepared for their careers; (c) the essential core-academic, general education, and non-academic elements of a relevant HVAC-ET program; (d) and what changes they perceived would improve the HVAC-ET program from the perspectives of pedagogy and relevance.

Most significantly, the study found that all graduates: (a) exhibited a strong positive attitude toward HVAC-ET; (b) harbored feelings of pride, gratitude and self fulfillment as a result of their experience; (c) were ambivalent toward general education; (d) identified the curriculum, the faculty, and the social environment as essential elements of a relevant HVAC-ET program; (e) felt well-prepared for their jobs; and (f) found the program to be aligned with the HVAC industry. Additionally, campus graduates cited the facility, internships, and industry-sponsored student organizations, while online graduates found the quality and organization of the online lecture series and prompt feedback to be as essential elements of their experience.

Though the study found HVAC-ET to be meaningful to the graduates and relevant with the industry, campus graduates recommended the addition of a contracting business course and program accreditation that would enable graduates to become professional engineers. Online graduates advocated for improved communication via faster feedback and continuous quality improvement of course materials.

CHAPTER 5
DISCUSSION, RECOMMENDATIONS FOR FUTURE RESEARCH, CONCLUSIONS

Overall Summary

A phenomenological study seeks to discover and describe the essence of a phenomenon through the personal meanings of that experience from the subjects' perspectives (Marshall & Rossman, 2006; Burke & Christensen, 2004; Bogdan & Biklen, 2003; Patton, 2002; Creswell, 1998). The phenomenologist expects these data to be diverse, scattered and complex (Marshall & Rossman, 2006). At the same time, though no two humans or human experiences are completely unique, the researcher expects to find some common ground among the differences in experiences. It is the commonality, the "essence" or "invariant structure" of the experiences that the researcher seeks out among the differences, or "variant structure" (Burke & Christensen, 2004).

In this study, though there was certainly a variety of experiences and perspectives, a number of common themes emerged that, when combined in a narrative format, describe the invariant structure of the HVAC-ET program from a phenomenological viewpoint.

Invariant structure of the HVAC-ET program

In the typical HVAC-ET experience, two critical alignments emerged. First, the program aligns sufficiently well with student needs and interests to be described as a "perfect fit" for them. Second, the curriculum aligns precisely with the design/applied engineering, controls, and energy sectors of the HVAC industry, as shown in Figure 3 (page 40). Because of these alignments, graduates perceive HVAC-ET as the premier educational program in their field and exhibit feelings of great personal pride and a sense of accomplishment due to their affiliation with and graduation from it.

Campus graduates gained confidence in their skills and abilities through early career success and felt better prepared for their jobs than coworkers from other universities. Online graduates felt a new level of credibility as the skills and knowledge they had developed through extensive industry experience was validated through their HVAC-ET degree. Ample employment opportunities that awaited campus graduates, coupled with promotions and elevated positions for online graduates, fostered a strong sense of job security.

Subjects felt the robust, core academic curriculum was enhanced by a number of contributing factors. For both campus and online graduates, the most significant factor was a faculty comprised of experts who were experienced in a diversity of industry sectors and cared enough to devote personal attention whenever needed. For campus students, the design and function of the Granger Center provided an unparalleled venue for experiential learning, and online students considered the quality and organization of the electronic lectures and course materials to be great learning aids. Both campus and online graduates found interaction with faculty and fellow students to be an important social element of their overall experience. While online graduates had extensive previous experience, campus graduates with little prior knowledge of HVAC found both the industry-sponsored student organizations and the internship to be extremely valuable tools for building networking connections.

Weaknesses perceived by campus graduates were the lack of a contracting business class, and a program accreditation that would enable graduates to become professional engineers. For online graduates, delayed feedback and poor communication were significant weaknesses, while outdated or inaccurate course materials were seen as minor weaknesses. Both groups were ambivalent about the general education portion of the degree, rendering it to be a non-essential element of the overall experience. A sense of gratitude was conveyed by the participants of this research, who as a group, were extremely positive about the HVAC-ET program, their experiences with it, and the preparation it provided them for their careers.

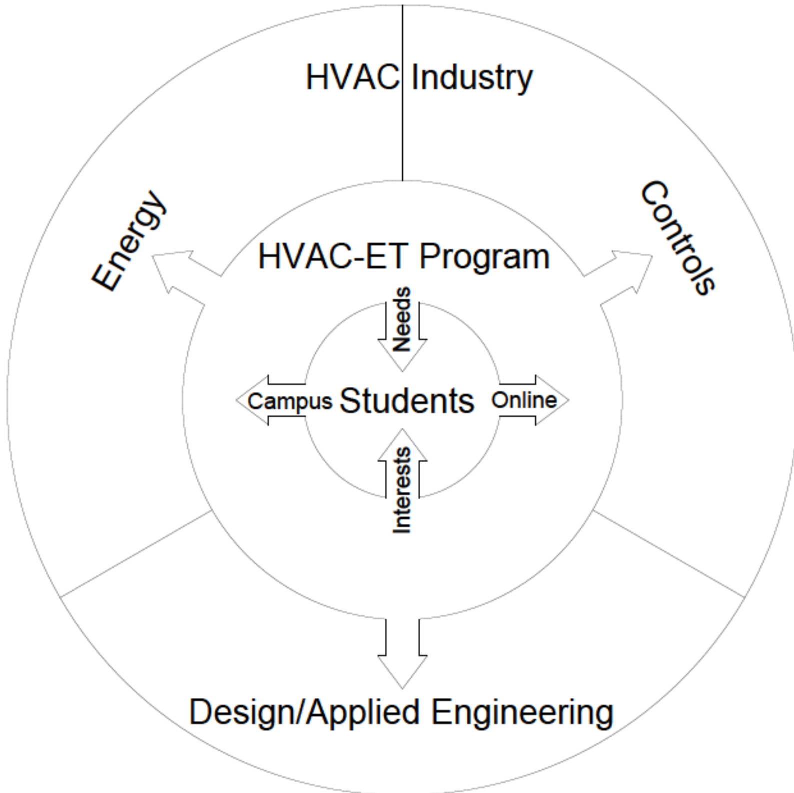


Figure 1. Alignment of HVAC-ET with Students and Industry

Purpose of Study

The purpose of this study was to investigate the phenomenon of industry-employed graduates of the Bachelor of Science in Heating, Ventilation and Air Conditioning Engineering Technology (HVAC-ET) at Ferris State University in Big Rapids, Michigan. In particular, the researcher was interested in learning what the educational experience meant to the graduates and how they perceived they were prepared for work. And from their perspectives, what the essential elements of the program are and what changes they would make to improve it.

Existing quantitative data indicated a high level of program quality in terms of how well graduates and their employers perceived the graduates were prepared for work in specific technical areas. These data provide a measure of how well the HVAC-ET program prepares its students for employment but do not provide definitive results that lead to improvement. A goal of the research was learn how the HVAC-ET aligns with the industry for which it prepares its graduates, as judged from the point of view of its graduates. A secondary goal of the study was to establish a process by which other CTE programs may be evaluated.

Research Questions

Research question one

Research question one asked what the HVAC-ET program meant to its graduates on a personal level. The participants in this study all exhibited a strong positive attitude toward the HVAC-ET program. There was a sense of accomplishment, pride, gratitude and self-fulfillment.

The campus graduates felt a sense of pride, both in themselves and in the HVAC-ET program. They were proud of their personal accomplishment, not only in graduating with a baccalaureate degree, but in doing well in school. Best described as a “perfect fit,” the program sparked an interest that fostered a high level of achievement in students that had not always been high achievers. Participants who reported being poor high school students, or college students who were aimlessly taking courses, found a focus in the HVAC-ET program that channeled their energy and motivated them to excel. This turnaround in performance or discovery of focus fostered a sense of pride in those who felt they were just poor students or who thought they would never graduate from college, let alone with a baccalaureate degree.

The online graduates also felt a sense of pride in accomplishment. For every one of them, the degree amounted to accomplishing a goal that had been long delayed for various reasons. With an average of just over 44 years of age, most of these participants had long worked in the HVACR industry with only an associate degree or no degree at all. With the associate degree as the terminal degree in HVACR (other than baccalaureate degrees from Ferris and Pennsylvania College of Technology), few of the online participants even knew of the HVAC-ET program. Those that did were prevented from enrolling until the program was offered online beginning in 2003. Like the campus graduates, the HVAC-ET program represented a perfect fit for the online graduates, albeit for different reasons than their campus counterparts. For all but one of the online graduates, the program represented a never-before offered opportunity to advance their education in the field they had been employed in for their entire careers. Achieving a baccalaureate degree at their age meant a great deal to these participants.

Both campus and online graduates are proud of graduating from the HVAC-ET program at Ferris State University. Though most of the online graduates live in states other than Michigan, they all had known Ferris as the premier source of HVACR education through trade journals and industry reputation. To hold a degree from a school with such a reputation is a sense of prestige to them. For the campus graduates, the reputation of the HVAC program at Ferris was either handed down to them by family members, or was discovered as they progressed through the program and into their careers. Participants who graduated from the campus program reported being surprised at how many people knew of the Ferris program, and found their way paved by the reputation that preceded them. (This reputation acted as a double-edged sword, as campus graduates found that a lot was expected of them, finding their introduction to employment via the "deep end of the pool.") Whether graduating from the campus or online program, participants perceived that they had earned a degree from the premier institution for HVAC in the country, and they took pride in that perception.

Research question two

Research question two asked how graduates perceive they were prepared for their careers. The campus graduates felt they were very well prepared for work, and found themselves with significant responsibilities in as little as six months out of school. Participants reported job duties that included substantial roles in design, energy auditing, sales and controls within their first year on the job. Their abilities inspired self-confidence and gained the confidence and respect of their colleagues and supervisors. Those who went to work for companies that had previously hired Ferris graduates found that their high performance was expected. Those who were the first Ferris graduate hired reported surprising their companies with their abilities and raising the level of respect for the HVAC-ET program within those companies.

Perhaps the term "ahead of the curve" best describes the campus graduates' perception of their preparedness for work. As new and untested employees fresh out of college, the campus graduates found themselves working with other new employees, many of whom were graduates of mechanical engineering schools. As discussed on page **Error! Bookmark not defined.** and again in brief on page **Error! Bookmark not defined.**, the HVAC-ET program is essentially a subset of the mechanical engineering field. Needing a benchmark against which to measure their expertise and gage their performance, campus graduates found their mechanical engineering colleagues to be a likely and available frame of reference and found themselves better prepared to perform HVAC-related functions. Their mechanical engineering counterparts were equally prepared to learn other aspects of the job including new software programs and sales techniques.

Two key features of the program helped connect campus graduates with the industry they would be targeting for work and alerted them to the requirements of, and opportunities in, the world of work that was looming just over their horizons. First, membership and involvement in one or more of the three student organizations available to HVAC students provided multiple networking opportunities. Sponsoring associations and societies of the student organizations including The Air Conditioning Contractors of America (ACCA), The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), and The Mechanical Service Contractors Association (MSCA) invite students to participate at the local and national level in their various conferences, conventions and expositions. Through travel to these events, the campus graduates were introduced to the breadth of the HVAC industry through personnel from various sectors of the industry including manufacturing, contracting, and engineering and came away with a new appreciation for the opportunities that were available to them throughout the United States. Conversations with industry personnel at these events gave the participants the chance to hear about the industry from those currently working in it. These conversations reinforced the value of the curriculum to the participants as they discovered that what they were learning was relevant to their future career opportunities.

The internship served as the second key feature, connecting school to work for the participants while they were students. Where travels to conferences, conventions and expositions provided a glimpse into the real-world, the internship provided immersion. The internship required a minimum of 10 weeks of work in the industry related to the learning objectives of the HVAC-ET program. The internship took place between the participant's junior and senior years of college. For some participants, the internship also provided the opportunity to travel to and live in a state other than their home state for the first time in their lives. As students, the participants were required to seek internship opportunities, make application for the job and follow whatever hiring procedures their potential employer required. For most of the campus graduates, the internship represented the first "full time" job they held within the HVAC industry. For all of them, it was the first time they were able to apply the knowledge they had learned in the HVAC-ET program to the world of work. The internship connected what they were learning in the classroom with the real-world, reinforced the relevance of the curriculum in their minds, and helped to build a level of self confidence in their abilities and knowledge. Exactly half of the campus graduates who participated in this study accepted full time employment with their internship employer following graduation.

For the online graduates, the term "prepared for work" had little meaning, as they had already been employed in the industry for 15.5 years on average. Instead, the HVAC-ET program provided validation for their experience, added credibility to their resumes, and broke through a ceiling that had prevented them from being promoted to an elevated position.

Their education provided a deeper understand of concepts they either already knew or thought they already knew. Further, the program introduced them to sectors of the industry where they had no experience and added to their knowledge base and skill set. For the online graduates, the degree often meant a transition from a blue-collar job to a white-collar job. For example, three of the participants needed the degree to transition from the role of a service technician to that of an instructor of HVACR. In other cases, participants who had started with entry level jobs and moved up through the ranks over time, then lost what had become high-level jobs due to corporate restructuring. Though they had the experience and expertise, they found it difficult to be hired for jobs with similar compensation packages due to the lack of a baccalaureate degree, but were able to secure new jobs of similar responsibilities once they had earned their degree.

Research question three

Research question three asked what the essential (a) core-academic; (b) general education; and (c) non-academic elements were of a relevant HVAC-ET program.

Core academics. A stated goal of this research was to learn how the HVAC-ET aligns with the industry for which it prepares its graduates, as judged from the point of view of its graduates. Both the campus and the online graduates found the core-academic courses to be relevant preparation for jobs in the design/applied engineering, controls, and energy sectors of the HVAC industry. This is a significant finding, as these are the three sectors targeted by the core academic courses within the HVAC-ET curriculum (see .

Table 2). A somewhat lengthy description of the individual core academic courses within HVAC-ET curriculum follows to provide the reader with some background and insight into the significance of this finding.

When the HVAC-ET program was developed in the early 1980s, industry stakeholders lamented the theoretical nature of the typical mechanical engineering program, and the resulting lack of practical engineering skills of newly hired graduates. In response to these concerns, the faculty started with the mechanical engineering discipline and borrowed only those engineering principles and applications necessary to pragmatically design mechanical (HVAC) systems for buildings.

Because proper HVAC system design is worthless without the application of automatic controls to operate the system in an efficient and effective manner, the curriculum was designed to incorporate a strong controls component. Based on the principle that students cannot learn controls until they learn the operation and application of systems, the program begins with an in-depth study of systems in HVAC 331: Secondary Equipment Selection and Design. The research subjects described this course as the “gateway” to the rest of the curriculum. While they found it to be challenging, they called it hard “in a good way” and proclaimed that they “learned a ton” in the course.

With 331 serving as a foundation, the first controls course, HVAC 312: HVAC Control Theory & Application, introduces students to control loop theory related to commercial and industrial comfort, process and safety applications and follows with an introduction to direct digital control (DDC), which utilizes the power of computer software to optimize system operation and efficiency.

Table 1
Crosslink: Industry Sectors and Core Academic Courses

Course	Design/ Applied Engineering	Controls	Energy
HVAC 331: Secondary Equipment Selection and Design	X		
HVAC 312: HVAC Control Theory & Application		X	
HVAC 342: HVAC Load Calculations and Energy Codes	X		X
HVAC 415: Digital Control Systems		X	
HVAC 451: Energy Analysis and Audit			X
HVAC 462: Primary Equipment Selection & Design	X		X
HVAC 499: Commercial HVAC System Design	X	X	X

HVAC 415: Digital Control Systems, the second and final controls course, provides application of theories learned in HVAC 312 as students learn to write the sequence of operation for a variety of common HVAC applications and then program systems located within the controls lab in the Granger Center. Many of the research subjects enjoyed the controls component of the program due to its hands-on nature, and several found employment in the controls industry as a result.

HVAC 331 serves as a foundation not only for the two controls courses, but also for the design component of the curriculum. The proper sizing of the heating and cooling equipment depends on the "loads" of a building. A heating load occurs during cold months and measures the net energy that is lost to the cold outside environment. Conversely, a cooling load occurs during the warmer months, and measures the net energy gained from the warm outdoor environment, the sun, and from the people and equipment within the building. Air that enters and exits a building also contributes to the load. Students learn manual load calculation methods, and perform load calculations of actual buildings using proprietary industry software in HVAC 342: HVAC Load Calculations and Energy Codes. As the title indicates, this course also provides the application of codes and standards as they apply to HVAC system design. A number of both campus and online graduates cited using lessons learned in HVAC 342 on the job, and a number of online graduates described how they had performed load calculations prior to entering the HVAC-ET program, but either learned more about the process or discovered that they had previously been using inaccurate methodologies.

With HVAC 331 and HVAC 342, students are able to determine loads in each room of the building and then properly size and route ducting and piping systems to deliver the appropriate amount of fluids (air and water) as needed to each room. The final step in the design process calls for the selection of the "primary equipment," which includes items such as chillers, boilers, cooling towers, and air handling units. These devices are available from a variety of manufacturers in a multitude of sizes and configurations to accommodate the needs of specific applications. In HVAC 462: Primary Equipment Selection & Design, students learn to use manufacturers' literature and software to research and select the appropriate primary equipment. A number of both campus and online subjects work for manufacturing branch offices and perform this function as a service for their engineering and contracting customers.

As the capstone course, HVAC 499: Commercial HVAC System Design, incorporates all of the design components into a final project in which students are given architectural drawings of an existing building located in a specific city and are asked to design a complete HVAC system. More than half of the research participants cited this class as particularly meaningful because of its real-world feel, its comprehensiveness, and its demand on students to make and defend decisions involving several valid choices.

With the pervasive attention given to energy conservation during the time the program was designed in the 1980s, the curriculum was developed with energy efficiency at the core of all courses, and included two courses that focused on energy audit and analysis. Since that time, the second audit course was converted to the current capstone design course. In the remaining HVAC 451: Energy Analysis and Audit course, students conduct an in-depth audit of a functioning building located within a one-hour radius of campus. The goal of this course is to provide practical experience of the audit and analysis process, as well as the opportunity to present findings to the stakeholders of the building, such as the building owner, facility manager, or board of directors. A number of research participants reported performing exactly this type of work in their jobs, and two subjects had titles of energy engineers.

In summary, research question three represents a significant finding. The three sectors of the HVAC-ET core academic curriculum, including design/applied engineering, controls, and energy auditing and analysis emerged from the data as the three sectors of the industry for which the research participants felt well prepared. Indeed, the participants, particularly the campus participants, felt they were better prepared than their co-workers with mechanical engineering degrees. This finding indicates that the HVAC-ET curriculum is exactly aligned with the sectors of industry for which it was designed to prepare graduates.

General education. The general education portion of the HVAC-ET program did not emerge as an essential element of the participants' experience and education. Where each participant could remember specific HVAC courses and even specific elements within those courses, many struggled to remember the general education courses they had taken. The overall attitude toward the general education courses would best be described as ambivalent. While some subjects thought the general education courses were very important and contributed to becoming a "well rounded person," others saw them as "road blocks" or courses they were "stuck with."

It is important to note that this finding does not mean the participants found the general education courses to have no value. At the same time, a theme did not emerge to indicate the courses did add value. The mixed feelings of the participants may indicate simply that the general education portion was not perceived as a significant component of their education or experience with Ferris State University and the HVAC-ET program.

As CTE students, the participants tended to have a singular focus that included only the HVAC portion of their degree. They know themselves as HVAC engineers and identify with the HVAC industry, so it is perhaps no surprise that they identify so strongly with the HVAC sector of their educational experience. This singular focus was further evidenced through comments made by the participants relative to selecting the HVAC-ET program due to its "narrow focus" and "concentration" on HVAC. Finally, some of the subjects spoke of doing poorly in high school or of not being strong students. It may be possible that their relative success and interest in the HVAC curriculum provided a positive self-image that blurred the memory of other sectors of education that were not as interesting or did not produce the same positive self-image.

Non-academic. For both the campus and online graduates, the faculty emerged as an essential element of their education and experience in the HVAC-ET program. Participants cited excellent lectures, personal attention and a genuine interest in their success. Professors were described as "excellent," "sharp," and "very knowledgeable." For the campus graduates, the fact that their professors knew them and knew them well was especially meaningful, as was the availability of the faculty and their willingness and even eagerness to work with students outside of class. For online graduates, the organizational skills of their professors were important. Since the students could not meet with their professors face to face, the organization of the course was a key element for effective time management. The layout and organization of the first course in particular was cited several times as an excellent and impressive example.

Not surprisingly, both campus and online graduates also cited social interaction with faculty and fellow classmates as meaningful. Campus graduates spoke of friendships they still have that formed on campus. For three of the campus subjects, friends were involved in their decision to attend Ferris, and for another, a friendship led to his current job. Campus graduates also described knowing their professor's personalities, and even "hanging out" with them during extra-curricular activities.

Though the online students were separated by geography, they still managed to set up social networks with each other. Through the use of electronic communication tools such as email and chat, students collaborated on assignments and projects and came to know each other in the process. Inter-student phone calls were also used for verbal communication, and in the case of two subjects, a close proximity in geography and a common bond as former soldiers led to a personal friendship that included visits to each other's homes. Of particular meaning to the online graduates was the on-campus laboratory course held during the summer following their first year in school. This provided the opportunity to meet the classmates and faculty they had been working online with for nearly a year. More than half of the online graduates spoke positively of the summer lab and the opportunities to meet the faculty, fellow students, and perform hands-on functions in the labs.

For the campus students, social interactions with fellow students will occur as they do on campuses everywhere. The interaction with the faculty is an important theme to emerge, not because it is unique to this study or program, but because faculty have an element of control. Though beyond the scope of this research, a literature does exist that explores a so-called "teacher effect" that can contribute to higher student achievement (Moye, 2010; Lockwood & McCaffrey, 2008). The knowledge that students find meaning in their interaction with faculty should provide a motivator for faculty who are truly interested in the success of their students.

The social interaction discussed by the online graduates is also outside the scope of this study, but has been the subject of much research and is recognized as an important yet difficult component of online learning to achieve (Watson & Gemin, 2008; Beuchot & Bullen, 2005; Santhiveeran, 2005). Strategies to foster better inter-student communication and closer bonding between students should be explored, not only to increase student engagement, but to develop stronger bonds between students, and increase student retention and achievement.

Research question four

Research question four asked what changes, if any, could improve the HVAC-ET program from the perspectives of (a) pedagogy and (b) relevance. Campus graduates cited the lack of two elements in the HVAC-ET program. First, from the perspective of relevance, the lack of ABET-accreditation prevents graduates from becoming professional engineers. (See page **Error! Bookmark not defined.** for more information on ABET.) For some of the participants, this represented a limitation in their current job. For others, earning a degree from an ABET-accredited program has become a goal, and one subject is actively working on achieving that goal. Another subject spoke about the lack of ABET accreditation, but then announced that he was not interested in doing the type of work performed by the professional engineers at his workplace.

For the faculty of the HVAC-ET program, ABET accreditation has been a topic of debate since nearly the founding of the program. Originally designed to be different from the traditional ABET-accredited engineering program that is most closely related to HVAC, i.e., mechanical engineering, the HVAC-ET program proclaims the difference in its name: "engineering technology" rather than "engineering." This was a purposeful design, which featured the elimination of the multiple calculus courses required in a typical engineering program, as well as the traditional foundational engineering courses such as thermodynamics, fluid dynamics, mechanics, dynamics, statics and materials. Instead, the curriculum was designed with the HVAC-specific courses listed in the appendix on page **Error! Bookmark not defined.**. And rather than incorporate the first two years of a typical engineering program, the HVAC-

ET program was designed with the associate degree in HVACR technology as a foundation, thus giving students the opportunity to learn HVACR fundamentals through hands-on learning.

As discussed on page **Error! Bookmark not defined.**, a program must be EAC accredited under ABET in order for graduates to write the P.E. exam in the state of Michigan. While the HVAC-ET program could attain TAC accreditation with relative ease and with minor changes to the curriculum, no benefit would be gained for graduates. For EAC accreditation, major modifications would be required. Such modifications would eliminate many of the core-academic HVAC courses that make the program unique. Without these courses, the strength of the program and its alignment with industry would be diminished or lost.

The uniqueness of the HVAC-ET program is both its strength and its weakness. As the participants of this study established, the strength of the program is its preparation of students for, and its alignment with, the design/application engineering, controls, and energy sectors of the HVAC industry. As a CTE program, this is a measure of success. The uniqueness of the program is also a weakness. As discussed on page **Error! Bookmark not defined.**, with only one other baccalaureate degree known to exist in the United States, no national or normative assessment tools exist as benchmarks for HVAC-ET, thus the need for studies such as this. From the ABET perspective, the pragmatic nature of the program prevents the very graduates it produces from becoming professional engineers.

This represents a perplexing paradox for the faculty of the HVAC-ET program. Campus graduates spoke of their participation in the ASHRAE student competition, both in terms of the significance of the experience itself, and in the case of two subjects, of being a part of a winning team. This competition features teams from engineering schools located throughout the world, most of which are ABET-accredited.

Table 3 displays the Ferris student record in two of the three categories in this competition, and illustrates a 13-year record of top finishes. The paradox is this: Ferris students compete successfully against students in ABET-accredited programs while in school, yet are prevented from competing on the same level once they reach the workplace.

Though the participants of this study are aware of the conundrum, they never-the-less wish they could become a professional engineer. Ultimately, this was a theme that has emerged in this study for which there is no solution.

The second element cited as lacking in the HVAC-ET program by the campus participants amounts to the business side of the industry and represents a pedagogical suggestion. Participants felt they were poorly prepared for project management, estimating, sales, and similar job functions. This is an area that had been addressed by the faculty between the time the participants graduated and the time they interviewed for this study. A new course was added to the HVAC-ET program as a part of an overall curriculum improvement process in the fall of 2009. The course title and description follow:

> HVAC 350: Contracting Issues in HVACR. The study of contracting issues as related to the HVACR industry. The course focuses on plans and specifications, estimating, budget issues, project management, economic cost analysis and codes and standards, all from the perspective of an HVACR professional. Lab exercises focus on application of contracting issues to a sample project (Ferris State University, 2010).

Table 2

HVAC-ET Student Record in ASHRAE Design Competition

Year	System Selection	System Design
1998	[a]	1
1999	[a]	2
2000	1	1
2001	1	1
2002	1	1
2003	2	1
2004	2	1
2005	3	
2006		2
2007	2	1
2008	3	[b]
2009	2	[b]
2010	2	[b]

Note. [a] Did not compete. [b] Rule change prevented Ferris students from competing.

After several campus and a few online participants lamented the lack of business-related learning objectives in the curriculum, the researcher read the course description for HVAC 350 to them and asked for their feedback. Responses such as “perfect,” “that pretty much hits it,” and “well there you go, you’re ahead of the curve” confirmed that the new course meets the needs they had spoken of. From that perspective, this research confirms the need for the class and reinforces the rationale for creating it.

For the online graduates, both of the themes to emerge for improving the program were pedagogical. The first involved updating the materials, both on the lectures and written course content. With the overall quality of the HVAC-ET online program, surprise was expressed when dated or erroneous content was discovered in the materials. Connor had said, “Instead of being a continually improving program, it just seemed to kind of hold its place in time.” Though two of the participants to comment on the materials were from the original cohort and quite understood that glitches are expected during a launch, one of the participants was in the sixth cohort, by which time one might expect corrections to be made. Two of the subjects thought the professors could and should update the materials as they teach them, using the words “take care of it as you go and then you don’t have to worry about it.”

The high expectations of quality communicated by the participants of this study provide an indication of the level of effort that is required to create and maintain an online version of a high-quality CTE program. Conversely, the comments of one subject about “outtakes” in the videos may indicate that a different level of quality is expected between campus and online content. No campus participants commented that their professor had stumbled over a word in class, lost his train of thought, or made a mistake at the board. Yet some of the online participants thought the program should be “flawless” after three or four years online. Whether this expectation is reasonable or not, it is none-the-less an expectation. The challenge for faculty who develop online lectures is to arrive at a level of quality that is less polished than a professionally produced film, yet of sufficient quality to aid in the transfer of knowledge without distraction. For written documentation contained in course pack documents, faculty of both campus and online programs are obligated to engage in an effort of continuous improvement.

The second theme to emerge from these data revolves around poor communication and delayed feedback. Though some delay in feedback is expected in online learning, participants expressed frustration even when their professor was prompt but not instant. When they were working on a project and had a question, participants said they had to wait until a response arrived. Because of their busy lives, it was difficult for them to complete work on time when their time for homework was available on the weekend and a response to a question did not arrive until mid-week when they had no time. This type of delay caused them to complete assignments one to several weeks later than they had planned due to circumstances beyond their control.

Participants also reported delays of several weeks, during which time they received no feedback whatsoever from their faculty, not even an acknowledgement that an assignment had been received. In these cases, the participants reported not only frustration but also stress due to not knowing if they were on the right track and concern over completing all of their work by the end of the semester.

There is a large and growing literature on issues with interactivity, communication, student satisfaction, and successes and failures of online asynchronous learning (Bray, 2007; Bolliger & Martindale, 2004; Burch, 2001; Valenta, Therriault, Dieter, & Mrtek, 2001). Though well beyond the scope of this study, it may be sufficient to report the general consensus that most students prefer face-to-face discussions to online discussions, even though the online discussions may be more convenient and flexible (Wang & Woo, 2007). It seems that the online HVAC-ET students have the same issues with communication as online students in general.

Whatever level of interaction faculty might have planned during their HVAC-ET online courses, clearly the participants expected more. And while delays of several days caused frustration, they were not unexpected and the participants displayed a level of understanding. However, the delays of several weeks were clearly unacceptable to them, no matter what the reason. The area of communication represents the greatest opportunity for quality improvement in the online program. Faculty of this and any other online CTE program might take note: Prompt feedback is a critical component of a quality online program and a significant element of a meaningful learning experience.

Practical Applications

In a phenomenology, it is important to give full deference to the experiences of the subjects. In this study, a number of significant implications warrant consideration. Campus graduates spoke of the barrier created by the lack of ABET accreditation. Though they felt the HVAC-ET program was strong, the feeling of being held back is an implication that the leaders of the program should study closely. At the same time, it is interesting to note that the subjects were not aware of ABET while they were students. They became aware of it only after entering the world of work and discovering the difference between a professional engineer and an engineering technologist. This indicates that not enough education on the topic is provided while students are in school. It is the responsibility of the university to provide students with the best possible preparation for their jobs and careers. If the attainment of professional engineer status is a valued attribute for graduates, then the HVAC-ET program should explore every avenue to seek a means by which the strength of the program can remain intact while providing the accreditation that would allow graduates to become professional engineers. This finding has implications not only for the faculty and leaders of the HVAC-ET program and Ferris State University, but for other researchers who study CTE programs. Perhaps there are desired outcomes of a specific CTE program of which they are not yet aware.

The repeated references to the Granger facility as an important asset to the learning environment are another important implication for educational leaders and other researchers to consider. The subjects felt this facility added to their educational experience and enhanced their ability to comprehend and understand their studies through the more tactile environment. Further, they often used the word “impressed” when describing Granger and conveyed their feelings with an almost Disneyesque sense of admiration. The architecture of the building factored into the decision to attend Ferris for some of the subjects.

This seems to imply that thoughtful consideration should be given to the architecture of learning facilities to explore means by which the facilities themselves might not only house CTE programs, but also serve as a part of the learning environment. While the innovations in the Granger center lend themselves to learning about the built environment, it is possible that enhancements can be made to other CTE programs by incorporating features related to the field of study into the facility or the surrounding environment. Further, the sense of wonder exuded by the subjects in reference to Granger indicates that the architecture of learning facilities can contribute significantly to the overall educational experience of the students. A literature search to determine how the architecture of academic structures impacts educational quality and experience was beyond the scope of this study. While studies may have already been conducted, future CTE researchers may be interested to employ qualitative methodologies to discover if synergies exist between curricula, facilities and the learning environment.

From an evaluative perspective, the self-worth conveyed by the subjects due to skills, knowledge and abilities in their work carries strong implications for educational leaders. If workforce development is the goal of a CTE program, then graduates who feel valued in their work is a strong indicator of program success. From a phenomenological perspective, increased feelings of self-worth represents a significant means of understanding the experiences of the subjects and emerges as a part of the essence of that experience. This finding carries implications that expand and enhance CTE beyond the simple concept of workforce development. If good CTE programming instills increased feelings of self worth, it follows that employees may be more satisfied with their jobs and may be more productive. The development of a competent workforce is one thing. Individuals who define their self-worth through the pride they take in their work is quite another. This kind of win-win concept is another area that might be explored with future research in CTE utilizing qualitative methodologies.

The significance of the social interaction with both faculty and fellow students carries implications for educational leaders to consider as a factor in the quality of the education that students receive. This factor has obvious implications on class size, as the reduction in the potential for student/faculty interaction varies directly with class size. While larger class sizes result in higher academic production and reduced demand on financial resources, educational quality suffers when measured by the faculty to student interactions that emerged from this study as a part of the essence of the subjects' experience. If faculty to student interaction is so important to students, whether on campus or online, educational leaders must consider this carefully when course capacities are under discussion.

In addition to providing information regarding the phenomenon of being a graduate of the HVAC-ET program, participants were also asked to consider what, if any, changes they would make to the program. The responses to the questions posed during this study provide thoughtful insight for both the faculty of the HVAC-ET program and for others who wish to consider foundational elements of a quality CTE program, or who may wish to make improvements to an existing program.

With the long history of CTE as workforce development or education for jobs (Rothwell & Gerity, 2008; Cohen, & Besharov, 2002; Sheppard, 1931) and federal legislation to regulate that education (Stone, 2002; Mobley, 1964), this study reinforces the importance of a curriculum that is aligned with the industry for which it prepares its students and provides strong evidence that a unique CTE program can and does have a role in the current educational system. The strong feelings of the participants that the HVAC-ET program perfectly fit their needs, provided excellent preparation for their careers, and fostered a strong sense of job security seem to indicate value in narrowly-focused CTE curricula.

From the perspective of credibility, though the public perceives CTE as something less than academic (Cohen & Besharov, 2002), the pride projected by the participants of this study indicate just the opposite. Career success and the strong national reputation of the HVAC-ET program instilled an attitude of superiority. This carries the implication that quality CTE programs can and do measure up to academic programs. It follows that efforts to improve the quality across the spectrum of CTE could improve its perception in the public eye. An important distinction must be pointed out: the HVAC-ET program is a baccalaureate-level degree. This is an anomaly within CTE, as the vast majority of programs exist at the secondary or associate degree postsecondary level. Perhaps this study makes an argument for elevating more CTE programs to the baccalaureate level.

Much work has been done to recognize the importance of integrating general education outcomes across all curricula including CTE (Humphreys, 2009; Meeder, 2008). The ambivalence of this study's participants indicates that from the students' perspective, that recognition is not clearly evident.

Opportunities for Future Research

This research focused solely on the perspective of the graduates of the Bachelor of Science in HVAC Engineering Technology from Ferris State University in Big Rapids, Michigan. As a qualitative study, a small number of subjects were interviewed using open-ended questions to obtain in-depth and rich information about their experiences as a student and a graduate. The results indicated that the program has a very strong position in the market via an exact alignment of the curriculum with the industry sectors of design/applied engineering, controls, and energy. No need for changes to the core academic curriculum was identified, though additions were recommended. For example, participants felt that a contracting business course would enhance their preparation for employment, and this recommendation confirmed the need for just such a course launched one academic year prior to this study.

The results of this study are valuable to all of the stakeholders of the HVAC-ET program. The rich narrative provides a much deeper understanding of program quality and relevance from perspective of perhaps its most critical stakeholders: the graduates working in the industry for which they were prepared. This study builds a foundation and provides a procedure for further research of specific CTE programming using a phenomenological methodology.

The results of this study represent a viewpoint of the HVAC-ET program from the perspective of its graduates. Several questions could be asked, such as: Do their employers perceive them and the HVAC-ET program in a similar manner? A study to interview the employers of HVAC-ET graduates would provide rich data against which the results of this study could be compared. Similarly, this study identified a difference in the perspectives of traditional campus graduates and non-traditional online graduates. The campus graduates felt they were prepared better than their coworkers who had graduated from mechanical engineering programs. While the online graduates felt they were well-prepared, they did not use such a comparison. Does this mean that the relatively inexperienced campus graduates hold a naïve perspective? Perhaps they are better prepared initially, but what happens after their first three years of employment? Do the mechanical engineering graduates catch up or even surpass the Ferris graduates over time? A similar study of mechanical engineering graduates (and their employers) would illuminate a different perception of their skill set in the workplace. The results of such a study may reinforce the recommendation made by campus graduates to accredit the HVAC-ET program under ABET in order to enable its graduates to become professional engineers.

Studies of HVAC-ET graduates five to 10 years and 10 to 20 years from graduation would provide a wealth of data from a longer viewpoint. How have they advanced in their careers? Did they remain in the HVAC industry? Has their education remained relevant? Does it still hold meaning for them? What value has general education held for them?

The results of this study are strong, though the literature suggests that evaluation in education is weak. Beyond the HVAC-ET program at Ferris State University, studies such as this could prove valuable for most any CTE program. Though this study was conducted as a part of a dissertation and required a significant amount of effort, the essence of the study could be replicated with much less formality and produce equally rich data. Such a study could be incorporated as a part of a cyclical self-study, such as the Academic Program Review utilized at Ferris State University, as discussed on page **Error! Bookmark not defined.**. Publication of the results of such studies would begin to strengthen the literature related to evaluation in education, and in CTE in particular.

The implications discussed under practical applications above suggest other areas that warrant further phenomenological study in the broader CTE field. How can the architecture of the academic facility enhance the learning of the student and contribute to the overall educational experience? What meaning do other CTE programs have for the graduates? What are the essential elements of other CTE programs from the perspective of the graduates? How does CTE contribute to the self-worth of graduates in the workforce? What are the essential elements of faculty to student interaction? How do faculty to student and student to student social interactions affect the overall educational experience of the graduate? The rich data provided from this narrow and deep qualitative study paves the way for other research to follow. The questions above represent but a few of the topics that could be explored by future research.

Conclusions

A number of conclusions can be drawn from this research. First and foremost, the educational experiences of both the campus and online graduates generated feelings of pride, accomplishment and self fulfillment. Participants were proud not only of their personal accomplishment, but also of the program from which they graduated. Their perception of the HVAC-ET program as the premier HVAC education in the United States exemplifies the depth of their pride. The perceptions of both the campus and online students represent a broad spectrum of life experience, industry experience, and responsibility. The campus participants represent the relatively young and traditional student demographic. With an average age of roughly 24 at the time of graduation, and with virtually no industry experience, their exuberant assessment of their early career success is perhaps tempered by the lack of a test of time. Conversely, the level of responsibility they have assumed as soon as six months into their careers is certainly a testament to their preparation and skill set.

At the other end of the spectrum, the online participants represent a non-traditional student demographic. Averaging 20 years older than the campus graduates and with an average 15 years of industry experience, the online graduates had gained life skills and progressed through their careers. Some have children as old as the campus graduates and are essentially one generation older. As a group, these participants knew of Ferris and the reputation of the HVACR programs through articles in national trade magazines before they started in the program. They arrived with high expectations, so their perception of the quality of the program and expressions of personal pride are significant statements. Equally significant is the confirmation that the HVAC-ET program is relevant in terms of its alignment with the industry for which it prepares its graduates. The three sectors of the HVAC industry which emerged as those for which the graduates felt they were superbly prepared were the same three sectors targeted by the faculty in 1984 when the HVAC-ET program was first launched in its on-campus version. The level of quality and focus perceived by both campus and online graduates affirms and validates the relevance of the program, the focus of the curriculum, and the work of the faculty. This study resulted in positive feedback, but the results would have been equally valuable had they been negative.

As with anything, there is room for improvement. Through previous work with alumni and employers, faculty had identified the need for a contracting business class and added the new class to the curriculum in fall 2009. This study confirmed the need for that class and added a level of validity for its place in the curriculum. As with any curriculum, the participants reinforced the need for continuous improvement of content. Though the expectation for flawless materials may be a bit high, the message that improvements are needed came across loud and clear.

The desire of graduates to become professional engineers has been and continues to be an issue with no apparent solution. To be qualified, students must graduate from a program accredited by the Engineering Accreditation Commission (EAC) of ABET. Inclusion of courses required to align with EAC requirements would necessitate the removal of core-academic HVAC courses, which would weaken or destroy the narrow focus of the program and render it similar to any number of engineering programs already available throughout the United States. Without additional years of school, there appears to be no solution that could combine both the strength of the narrowly focused HVAC-ET curriculum with the broad-spectrum, foundational engineering principles of an ABET EAC accredited program.

The most pressing need for improvement involves communication in online classes. For the faculty of the HVAC-ET program and for any reader who teaches online, the participants sent a strong signal that minimal delay is expected when waiting for online feedback. Despite the deficiencies identified, subjects were overwhelmingly positive about the HVAC-ET program, their experiences with it, and the employment they had achieved as a result of it.

Perceptions of the Common KSAPC of Successful HVACR Technicians

Brian Holton

ABSTRACT

This research study investigates through qualitative research, the technical and professional soft skills perceived as common to successful heating, ventilating, air conditioning, and refrigeration (HVACR) technicians. Research studies directly related to technicians' in any skilled trade is limited. Available literature focuses primarily on technical skills and is limited in the issues of personal characteristics and the affects that environmental concerns and energy conservation is having on the occupation of HVACR technician. Advances in technology constantly affect the Knowledge, Skills, Abilities, and Personal Characteristics (KSAPC) that are required for a successful HVACR career. The research explores what technicians, employers, and customers perceive as essential KSAPC for technician success, and what educational institutes and certification programs should possibly consider essential for technician success. The research includes the perspectives of service technicians and service managers from multiple companies and specialties within the HVACR industry and the perspectives of customers served by the technicians. The research methodology is based in grounded theory and includes open- ended interview questions, field observations, and document analysis.

CHAPTER 5

SUMMARY, CONCLUSIONS & RECOMMENDATIONS

Summary of concepts derived from data analysis

Experience is an important characteristic that affects an individual's ability to perform at a level required for success and important for employment opportunities but not necessarily something that differentiates those that are more successful from those that are less successful.

Experience will not improve a technician's chance for success if they do not also have the ability to learn from their experience.

Customers served by technicians may perceive an older technician as being experienced with an associated perception that the individual is competent; this perception will not however have a lasting affect if the technician cannot perform at an acceptable level.

Knowledge specific to HVACR, is important for success.

Successful technicians' have the ability to apply their knowledge in real life applications, the ability to transfer knowledge to new applications and the motivation to seek out new knowledge.

Theoretical knowledge is important but not necessarily perceived as the most important for success.

Technician's that first obtain, and then maintain the knowledge required to perform at a level that peers and customer respect are inclined to possess desirable personal characteristics that support success.

Academic credentials will affect what employment opportunities are available for technicians but academic credentials are not widely perceived as important for success.

Grade point average, a typical indicator of academic success, is not commonly associated with technician success.

Perspectives tend to be at one end or the other of a continuum.

Good reading skills are a common characteristic of successful technicians.

Good *basic* writing skills are a common characteristic of successful technicians, and yes, spelling is important.

Basic math skills are required for success but advanced math skills are not common among successful technicians.

Good communication skills are common among successful technicians and one of the key elements of success.

The communication skills required for success include the following skills and abilities:

- Listening (active listening)
- Skills and abilities to clearly explain problems and repair solutions, both in writing and verbal forms
- The ability to read the other person's body language or other non verbal communication and communicate at a level they will understand

The ability to learn from experiences is a common characteristic of successful technicians.
Successful technicians have the ability to solve problems logically.

Successful technicians have a solid understanding of electricity and the ability to read electrical diagrams and troubleshoot electrical circuits.
Perceptions associated with the mechanical skills and abilities of successful technicians are not consistent.
Strength, as a physical characteristic is not necessarily common among successful technicians.
Coordination and manual dexterity are common among most technicians and not a specific characteristic of the successful technicians.
Good interpersonal skills are essential and common among successful technicians.
Good interpersonal skills are at least as important as, and very possibly more important than technical knowledge, skills, and abilities.
Conflict management skills are common among successful technicians.
Good work ethics play a significant role in success for the occupation of HVACR technician and therefore common among successful technicians.
The desire to do a good job is a common attitude among successful technicians.
A clean, neat appearance is a common personal characteristic of successful technicians.
Confidence is a common personal characteristic of successful technicians.
Motivation is a common personal characteristic of successful technicians.

Conclusions and recommendations

The interview responses and the field observations entail interpretations resulting in generalizations vs. absolutes. The personal interviews proved effective and efficient for revealing the perspectives of the participants. Field observations proved time intensive and inefficient for collecting data related to the categories of knowledge, skills, and abilities. An eight-hour workday reveals limited knowledge, skills, and abilities data specific to the tasks required that day. The knowledge, skills and abilities, and personal characteristics, for the occupation studied are diverse and extensive field observations would be required to allow for accurate generalizations for all aspects of the occupation. Field observations are reasonably effective for observing general personal characteristics but are inefficient for specific topics; for example, there was no opportunity to observe the technician's conflict management skills.

The interview responses, field observations, and document analysis provide insight to the knowledge, skills and abilities, and personal characteristics of successful technicians. The data provides educators, students, and HVACR professionals the opportunity to read the opinions and values of multiple HVACR professionals with extensive experience and expertise. Educators, students, and technicians striving for success, can gain a deeper understanding of what professionals consider important and necessary for success. Educators can use the results to assist in curriculum development. Managers can use the results to reflect on the knowledge, skills and abilities, and personal characteristics of existing technicians' and provide or encourage continuing education and training to address weak points.

This research study did not provide data that increases knowledge related to the effects of the *green movement* for the occupation of HVACR technician. Specific questions would have to be included to elicit responses specific to the green movement topic and coordination of field observations would be required. The fact that no research participant discussed the effects of the green movement and the field observations did not reveal effects of the green movement, suggests that the effects are minimal or concentrated to specific applications at the time of this research study, and within the region studied.

The research results indicate numerous, gaps between what industry professionals consider important for success and the focus of educational institutes. In addition to developing a deeper understanding of the common characteristics of successful HVACR technicians, the findings of this research study can facilitate an answer to the question: Are educational institutions teaching students subject matter that is not required for success while at the same time, not teaching subject matter that is truly required for success?

Concerning the topic of personal characteristics, perhaps the most interesting and complex elements of the research study; the findings of this research study confirm that personal characteristics will have a substantial influence on HVACR technician success. These research results corroborate the findings of a research study conducted by the North Virginia Community College Office of Institutional Research (2000) and, the Technology Advisory Council of New Mexico (2000). Those studies focus on employers' perspective and suggest that academic programs should focus on enhancing soft skills. The results of this research study and results of other available research provide credible evidence for the need to modify existing HVACR curriculum and training courses to include the development of those personal characteristics perceived as essential for success. The most noticeable personal characteristics detected during the field observations were conscientiousness and agreeableness; those characteristics serve the technicians well.

The results of this research study and available literature revealed that the current emphasis on mathematics is unwarranted for the occupation of HVACR technician. The following generalization is a result of this research study; a high school introductory algebra course provides and exceeds the most advanced mathematics required for success in the occupation of HVACR technician. An examination of the textbook, *Introductory Algebra* (Kaseberg, 2000) shows that the content exceeds the mathematic needs perceived as necessary for technician success. This issue has significant importance for HVACR education programs, as many technical programs and career counseling services place significant importance on math competencies. Some career counseling services may be misleading our youth regarding required math competencies for technology related occupations, and therefore unnecessarily discouraging individuals from pursuing a career in HVACR technology.

An essential component of communication skills is the willingness to communicate. A technician needs to understand the importance of communications and have a genuine interest in communicating with their co-workers and customers. Educational institutions may provide courses that help students gain confidence when speaking to the public, and they may teach individuals active listening skills but the willingness to communicate, and the ability to read body language and other nonverbal communications are characteristics that are unique to every individual and not likely to be included in traditional educational programs.

The importance of listening is one of the communication skills commonly discussed during the interviews and perceived as important for success. This significant finding exposes a skill that most, if not all, individuals need help developing. Based on the responses from the research participants', listening skills are more important than many academic subjects currently emphasized. Consider the hours that students devote to mathematics and language arts compared to specific education designed to improve listening skills. Listening is a skill that can, and should be, developed in educational institutions and corporate training programs.

Interview questions related to experience and knowledge exposed the following elements perceived as important, and common among successful technicians:

- Good comprehension
- Learning from, and remembering past experiences
- Ability to transfer knowledge learned from their own, and others experiences to new applications and for creative solutions

Research participants perceive the ability to solve problems using a methodical and logical approach as a common characteristic of successful technicians. Some standards recognize these skills, and one example is the workplace readiness standards by the Virginia Education Department (1999) that includes reasoning, problem solving, and decision-making skills. HVACR educational and training programs would benefit from curriculum designed to focus on the development of these skills.

The observed writing tasks required *very* basic skills regarding grammar, punctuation, and mechanics of writing. The ability to summarize the work performed, into clear and concise statements comprehensible to the customer, and the individual that produces an invoice, represents the larger challenge for technicians.
Based on the research observations and personal experience, traditional English writing courses do not prepare technicians for the style of writing they most often are required to perform. The work reports that are very common among the HVACR occupations may include fragmented sentences with very brief descriptions capturing only the essential details. Skills learned in commonly taught creative and composition writing would be counterproductive and would require that technicians' unlearn those writing skills. Wordy and lengthy work descriptions are inappropriate in most cases. Even technical writing courses lack the proper focus required for the writing skills most often required in the occupation of HVACR technician.

Section 3 – Program Profile

The following information pertains to the profile of students, program enrollment, program capacities, student success and retention, access to courses, curriculum requirements, quality of instruction, faculty quality and workloads, assessment and administration effectiveness. In the following sections 2-year students will be indicated as "HVACR Technology" students and 4-year students will be indicated as "HVACR Engineering Technology" students.

A. Profile of Students

1. Student Demographic Profiles

   a. The HVACR Technology and HVACR Engineering Technology students for the fall of 2007 to fall of 2011 illustrate the following Gender, Race/Ethnicity and Age breakdown.

				HVACR Technology Students									
Term	Enrollment	Male	Female	Unknown	Black	Hispanic	Native	Asian	White	Hawaiian	Multi	Foreign	Age
200708	81	81	0	0	3	2	0	0	76	0	0	0	21
200808	63	62	1	0	2	1	0	1	59	0	0	0	20
200908	59	58	1	3	2	1	1	0	51	0	1	0	21
201008	65	64	1	3	0	0	1	0	59	0	2	0	21
201108	60	58	2	1	2	1	0	0	53	0	2	1	21

				HVACR Engineering Technology Students									
Term	Enrollment	Male	Female	Unknown	Black	Hispanic	Native	Asian	White	Hawaiian	Multi	Foreign	Age
200708	130	130	0	8	11	1	0	3	101	0	0	6	31
200808	127	126	1	3	7	6	0	3	105	0	0	3	30
200908	147	146	1	5	8	5	0	1	124	0	0	4	30
201008	153	153	0	7	13	2	0	4	120	0	0	7	30
201108	156	155	1	12	14	3	0	5	116	0	0	6	31

   b. The HVACR Technology and HVACR Engineering Technology students had the following "In-State" and "Out-of-State" status from fall of 2007 to fall of 2011.

	HVACR Technology			HVACR Engineering Technology		
Term	Resident	Widwest	Non-Resident	Resident	Widwest	Non-Resident
200708	75	6	0	95	7	10
200808	58	4	1	97	14	16
200908	56	3	0	130	9	8
201008	61	2	1	139	8	6
201108	54	3	3	137	8	11

c. The HVACR Technology and HVACR Engineering Technology students had the following "Full-Time" and "Part-Time" status from fall of 2007 to fall of 2011.

	HVACR Technology		HVACR Engineering Technology	
Term	Full-Time	Part-Time	Full-Time	Part-Time
200708	78	3	62	68
200808	60	3	75	52
200908	56	3	84	63
201008	61	4	71	82
201108	56	4	71	85

d. The HVACR Technology classes are only offered during the daytime of Monday through Friday, at this time there are no evening and/or weekend classes offered. The HVACR Engineering Technology classes are offered in one of two venues. The on-campus classes only occur during the normal daytime hours of Monday through Friday at this time. The other option for the HVACR Engineering Technology classes is through the fully On-line program here at Ferris State University. There are no evening and/or weekend classes on campus for the HVACR Engineering Technology degree.

e. The HVACR Technology students do not have the option for On-line delivery as the Labs include required hands-on learning outcomes. However, the HVACR Engineering Technology program has a history of "On-line Delivery" and the following represents the Graduate Headcount for the HVACR Engineering Technology students for On-campus, Off-campus and On-line delivery.

Academic Year	On-Campus	Off-Campus	On-Line
2008-2009	29	0	2
2009-2010	42	0	3
2010-2011	42	0	10

f. The HVACR students within the HVACR Technology program do not have 100% On-line delivery, but several of these instructors do blend parts of their class into the Ferris On-line instructional platform. The main purpose of this blended approach is to offer students easy access to items such as the "Grade Book", class "Reference" materials, class "E-mail", and the ability for instructors to post announcements to their students. Thus all HVACR Technology students are being exposed to part of the on-line delivery, yet the vast majority of instruction is still the traditional on-campus instruction. The HVACR Engineering Technology program has on-campus and 100% On-line delivery classes; plus, all of the instructors for this program blend parts of their on-campus classes through the Ferris On-line instructional platform. The following table gives an indication of the amount of "Student Credit Hours" for On-campus and On-line delivery for the HVACR Engineering Technology students.

Academic Term	On-Campus	On-Line	Total
200908	1223	244	1467
201008	1098	298	1396
201108	1030	338	1368

g. The impact of student profiles on curriculum supports why the Ferris State University HVACR program is the example of excellence in the educational options for an Associate degree in HVACR as we continue to be the benchmark for other educational programs. As such we make sure to schedule the HVACR Technology classes in time blocks where each student is ensured to have an opportunity to follow our "check sheet" for graduation. We also have a population of Pre-HVACR Technology students each year where their start with the HVACR classes in January and not August. We try each year to accommodate time blocks for these students to still complete their core HVACR classes in a timely manner. All core HVACR classes within the HVACR Technology program are delivered on-campus with hands-on learning to support "Left-Brain" learning. The HVACR Engineering Technology program is one of only two such programs in North America that offers a Bachelor Degree in HVAC Engineering Technology. We are the only such program in the world to offer this degree via distance On-line learning. Thus, we have an unusually high rate of transfer students within our program and are why our average student age within the program is much higher than typical Bachelor degree programs. Because the On-line student is typically a working adult, our delivery methods include recorded lectures, most forms of on-line communication of course material, classroom community building, and learning modules.

2. Quality of Students
   a. The following information illustrates the range and average GPA and ACT for enrolled HVACR Technology students and HVACR Engineering students within the HVACR program. As can be seen in the following charts, the ACT scores of both student groups are similar; yet, the HVACR Engineering Technology students have a higher average GPA. This is due the significant enrollment of nontraditional students in the 4-year HVACR program and illustrates why our program is highly visible to the HVACR industry and community colleges throughout Northern America.
      i. HVACR Technology GPA and ACT

HVACR Technology			
Academic Year	Average GPA	Minimum GPA	Maximum GPA
2006-2007	3.13	2.38	3.88
2007-2008	2.97	2.04	4
2008-2009	3.11	2.31	3.9
2009-2010	3.01	2	3.92
2010-2011	3.08	1.92	3.95

HVACR Technology			
Academic Year	Average ACT	Minimum ACT	Maximum ACT
2006-2007	20.11	16	25
2007-2008	19.38	15	25
2008-2009	19.88	14	26
2009-2010	19.61	15	27
2010-2011	20.72	15	28

ii. HVACR Engineering Technology GPA and ACT

HVACR Engineering Technology			
Academic Year	Average GPA	Minimum GPA	Maximum GPA
2006-2007	3.43	2.678	4
2007-2008	3.35	2.25	4
2008-2009	3.28	2.19	3.98
2009-2010	3.44	2.65	4
2010-2011	3.46	2.67	4

HVACR Engineering Technology			
Academic Year	Average ACT	Minimum ACT	Maximum ACT
2006-2007	21.63	18	31
2007-2008	19.78	15	27
2008-2009	19.75	16	27
2009-2010	20.56	14	30
2010-2011	20.04	14	33

b. Separate Graduate GPA and ACT values were not available at the time of this document.

c. An additional means to assess our HVACR Technology students would be to illustrate the Perkins Core Performance Indicators from 2008-2009 as our program has received Perkins funding for equipment since our last program review. The following table indicates this measurement. Our students enjoy an extremely high rate of employment and exceed the State Performance Level Expectations.

Core Indicator (Perkins IV)	State Perfromance Level Expected	College	Program
1P1: % of CTE concentrators who passed technical skills asessments that are aligned with industry-recognized standards, if available and appropriate, during the reporting year(that can be identified)	85.25%	89.47%	N-A
2P1: % of CTE concentrators who received an industry-recognized credntial, a certificate, or a degree during the reporting year.	28.25%	69.68%	53.85%
3P1: % of CTE concentrators who remianed enrolled in their original postsecondary institution or transferred to another 2- or 4-year postsecondary institution during the reporting year and who were enrolled in postsecondary education in the fall of the previous reporting year.	60.25%	69.45%	100%
4P1: % of CTE concentrators who were placed or retained in employment, or placed in military service or apprenticeship programs in the 2nd quarter following the program year in which they left postsecondary education (ie: unduplicated placement status for CTE concetrators who graduated by June 30, 2008 would be assessed between October 1, 2008 and December 31, 2008)	43.25%	91.70%	100%
5P1: % of CTE participants from underrepresented gender groups who participated in a program that leds to employment in nontraditional fields during the reporting year.	16.75%	16.84%	1.59%
5P2: % of CTE concentrators from underrepresented gender groups who completed a program that leads to employment in nontraditional fields during the reporting year.	13.25%	12.84%	0

d. The HVACR students have earned a large number of scholarships and many of these scholarships only to HVACR students through professional organizations, private individuals, industry related companies and the program itself. Scholarships awarded each year total over $25,000, not including the scholarships student pursue on their own merit.

e. The HVACR students participate in a variety of events which are related to awards and/or scholarships. An example is the “Heats On” program each fall where students donate their time for community service to lower income and needy persons looking to get their heating equipment up and running prior to the heating season. The students work together with local HVACR contractors and suppliers in this endeavor and gain valuable experience not only dealing with equipment but learning soft skills. Students also raise the visibility of Ferris HVACR programs in international competitions through Engineering and Contracting professional organizations. Through the professional society of ASHRAE (American Society of Heating, Refrigeration, Air Conditioning Engineers) Ferris HVACR students have been recognized with awards more than any other University in the world. Through the professional organization of MSCA (Mechanical Service Contractors of America) the Ferris HVACR students have been named the student chapter of the year several times. The HVACR students through these professional organizations get exposure to conventions, workshops and professional meetings with technical presentations.

f. Other accomplishments of the HVACR students at Ferris include activities of the student chapters related to professional organizations, ASHRAE, MSCA, and ACCA (Air Conditioning Contractors of America). These organizations provide guest speakers for student activities which are relevant to current topics in HVACR.

3. Employability of Students
    a. The Graduate Surveys for 2009-2010 indicate the HVACR Technology students had all but 2 students with employment at the time of reporting (these students later received employment within the one year of graduation). The same Graduate Survey indicated all but one of the HVACR Engineering Technology students had employment at the time of reporting (this student later received employment within the one year of graduation).
    b. The Graduate Surveys for 2009-2010 indicated that the starting salary for HVACR Technology students was $35,000 (this was only a sample as most of the students did not indicate a starting salary). Historically the HVACR Technology graduates receive starting salaries in the range of low 30s to the low 40s. The Graduate Surveys for 2009-2010 indicated that the starting salary for HVACR Engineering Technology students was $62,278 (this again was a sample due to non 100% reporting by students). Historically, the HVACR Engineering Technology graduates receive starting salaries in the range of mid 40s to high 50s. It is apparent the HVACR Engineering Technology students are in a position of higher demand as the starting salaries have increased significantly since our last program review report.
    c. Typically HVACR Program Graduates do not become employed as part-time or temporary workers due to their very high (practically 100%) employment after graduation.
    d. Career assistance to students is available in several different methods. The first is through Career Services and the Job Fairs, where students sign up for interviews and directly engage with visiting companies. Another way students interact with outside companies for career assistance is when outside companies come to the Granger Center to meet with all HVACR students (show and tell session).

Companies give overview presentations and have informal interaction with students, many of these companies then have student interviews at a later date. HVACR faculty assist students in resume and cover letter creation and our advisory board each fall does "mock interviews" with students.

e. Although we do not keep written record of each student's activity after graduation, it is the opinion of faculty, graduates, and advisory board members that our HVACR graduates continue to be employed in the HVCAR industry due to the extremely wide range of career paths and potential high pay. (see appendix 1 & 2)
f. A considerable amount of HVACR graduates are employed in Michigan. However, there is a growing trend of graduates gaining employment in many states across North America. This is due in part from global organizations like Johnson Controls, Honeywell, Siemens, Carrier, Trane, and others which are pursuing our graduates for positions outside of Michigan. The addition of our On-line Bachelor degree has opened the exposure of our program to all states and the world (Middle East, Caribbean. etc…).
g. Approximately 40-60% of our 2-year graduates continue on into the 4-year degree program. Additionally, we have seen some 2-year graduates return after several years of employment to continue their education (either on campus or on-line).
h. Graduates of our Bachelor degree program could continue their education in many ways depending on their individual career path. Some continue with some form of business degree while others may pursue additional electronic or mechanical design education. Any of these choices are usually pursued via on-line delivery.

B. Enrollment

1. The anticipated enrollment for this coming fall should be similar to our last two school years with approximately 220 total students in the HVACR program.
2. Student credit hour production (SCH) and student enrollment for the HVACR program from the last program review are shown below. The numbers indicate the enrollment of the HVACR program has remained strong and is slightly increasing. The SCH for HVACR students has also remained strong and the slight changes are due to the drop/add of on-line students and their related courses for graduation. Overall, the HVACR program continues to have a strong enrollment and healthy SCH.

Academic Year	# of Students	SCH
2006-2007	215	3,179
2007-2008	222	3,604
2008-2009	204	3,121
2009-2010	219	3,652
2010-2011	231	3,198

3. According to the information furnished by the Dean's office, the number of applicants to the HVACR 2-year program for fall of 2011 was 51. The number of admitted students to the HVAC 2-year program in 2011 was 27 and of these students 26 enrolled in the

HVACR 2-year program. The number of applicants to the HVACR 4-year program (on-campus) for fall of 2011 was 61 and of these 46 were admitted to the HVACR 4-year program. The number of students enrolled into the HVACR 4-year (on-campus) program was 45 for 2011. The number of applicants to the HVACR 4-year (on-line) program for fall of 2011 was 63 and of these 34 were admitted. The total number of enrolled into the 4-year HVACR (on-line) program was 33 for fall of 2011. These numbers have been very typical for the past 4 years.

4. The percentage of students admitted from applicants varies slightly from year to year. In the HVACR 2-year program this percentage is a little more than 50%. There is no one reason why this percentage is not higher. Reasons range from ACT scores to poor high school GPA to issues with international admission requirements. In some cases students which did not receive admission return later with better application documentation and receive admission to the HVACR 2-year program. The percentage of students admitted from applicants to the 4-year (on-campus) HVACR program is also slightly over 50% and the reasons for why students do not gain admission is extremely wide in range. This is due to the growing number of transfer students into the FSU HVACR Bachelor Degree program (it should be noted that about 40% of those admitted are program change students from the FSU HVACR 2-year program). The percentage of students admitted from applicants into the On-line HVACR 4-year program is approximately 50% and a very large percentage of these students are transfer students which obtained their 2-year degree at some other institution. This is why our percentage is low due to extremely wide variations in 2-year degree transcripts.
5. The good news is the percentage of students enrolled form those admitted into the HVACR 2-year and HVACR 4-year programs is very high (over 95%), this is due to the uniqueness of the FSU HVACR programs and the national reputation the HVACR program maintains. Additionally, once we get a potential student and parent to the Granger building and illustrate the advantages of the HVACR program, it is virtually a sure thing we will get that potential student enrolled.
6. The goal of the HVACR program is to continue a growth of our program. We are aggressively offering scholarships to incoming freshmen and students have access to many other scholarships which attract students to both the Associate and the Bachelor degree programs. Our On-line offering of the Bachelor degree continues to attract students from all parts of North America and the World.

C. Program Capacity

1. The program capacity is currently set at 32 students for each year, freshmen through senior; however, we have experienced six straight years of starting more than 32 students at the junior level on campus. This is due to the tremendous amount of student applications from transfer students wishing to earn their Bachelor degree in HVACR since we are a 2+2 program. This extra demand for students in the on campus Bachelor degree has forced most faculty into overload teaching assignments (at times beyond the normal contract number of credit hours or contact hours). It should be noted the HVACR program has a dedicated marketing person, stable faculty and facility; therefore, the program can

absorb this demand on a short term basis, but as will be seen in workload the faculty cannot keep up this pace forever.

2. The Bachelor degree was transitioned to an On-line delivery ten (10) years ago and this has added another 32 students per fall to our enrollment. However, the retention of these students is difficult as all of these students are working adults and most have never taken an on-line course from a University.

D. Retention and Graduation

1. The attrition rate for HVACR students are shown below. In each table the number of students are indicated after the year (example: 2006 – 32), this means there were 32 students in 2006.

Fall 2006 - 32	Year 2	Year 3	Year 4	Year 5	Year 6
% Graduated By	0	28	47	59	66
% Still Enrolled	84	41	12	7	0
% Persisters	84	69	59	66	66
% Non-Persisters	16	31	41	34	34

Fall 2007 - 17	Year 2	Year 3	Year 4	Year 5	Year 6
% Graduated By	0	53	71	71	
% Still Enrolled	76	23	0	0	
% Persisters	76	76	71	71	
% Non-Persisters	24	24	29	29	

Fall 2008 - 19	Year 2	Year 3	Year 4	Year 5	Year 6
% Graduated By	0	37	37		
% Still Enrolled	74	31	21		
% Persisters	74	68	68		
% Non-Persisters	26	32	32		

Fall 2009 - 15	Year 2	Year 3	Year 4	Year 5	Year 6
% Graduated By	0	40			
% Still Enrolled	100	47			
% Persisters	100	87			
% Non-Persisters	0	13			

Fall 2010 - 14	Year 2	Year 3	Year 4	Year 5	Year 6
% Graduated By	0				
% Still Enrolled	86				
% Persisters	86				

% Non-Persisters	14				

2. The current goal for retaining students is keep our standards high and encourage students to their best performance through many learning methods, continuing instructional improvement and student involvement in the various program activities outside of the classroom (student RSO groups, industry partners, industry events, etc…). Our strategies include the above along with attracting high quality students through scholarships and working with traditional partners (high school technical programs, community colleges, and industry trade schools) to attract highly motivated students.
3. The number of degrees overall in the HVACR program has varied slightly since our last program review. The slight variation is due mainly to the expansion of the on-line degree program and the retention issues related to fully on-line students.
4. Most students enrolled in the HVACR 2-year program graduate with their Associate degree in the normal 2 year time frame; however, there are a small percentage (10-20%) of the HVACR 2-year students which need an additional semester, this is due the number of Pre-HVACR Technology students enrolled each year. Typically these students lack either the Math or English skills to start at the normal first semester check sheet list of classes and MATH116 is a co-requisite to the first two HVAC classes. As for the HVACR 4-year program students, most graduate in the normal timeframe. However, it is normal to see a few students (about 5%) which cannot graduate in the normal timeframe. This is usually due to issues related to transfer credits, international student issues, or financial aid limitations.
5. The average length of time for a student to graduate in the HVACR 2-year program is 2 years at Ferris State University. The average length of time for a student to graduate in the HVACR 4-year program is 2 years, this is due to the fact the HVACR program is a 2 plus 2 program. It is assumed a student already has an Associate degree when entering the 4-year program.

E. Access

1. The HVACR program has a history of making itself accessible to students through many ways. In the 2-year HVACR program, most of the courses are offered both fall and spring semester so students can start their core courses either semester and not be penalized. In the 4-year HVACR program all of the courses have now been successfully transitioned to on-line delivery and we offer on-line HVACR 300 and 400 level courses all three semester of the year. This was done back when we started the on-line degree offering, we have now been through 10 cohorts of on-line students. We have allowed some on-campus students to be enrolled in the on-line HVACR courses in special situations to help them stay on track for graduation.
2. The actions described above in item 1 have maintained a steady faculty load throughout the year and have created a steady use of the HVACR lab facilities and equipment within the Granger building. The expansion of the on-line degree and steady number of on-line students has raised the awareness of the FSU HVACR program nationally (internationally in some areas of the world), this is why we enjoy a high rate of applicants each year.

3. The actions described above in item 1 have created some good problems. First is the HVACR program has been operating at approximately 0.8 FTEP overload for the past several years and this includes the HVACR coordinator with only 25% release time. Continued enrollment as we have seen it the past few years should indicate a need for another tenured faculty position within the HVACR program. Additionally, as we are now part of the School of Built Environment, there has been discussion of new classes. At the present enrollment of HVACR students within the HVACR program, we do not have the faculty resources to undertake this School of Built Environment potential curriculum.

F. Curriculum

1. The curriculum for both the 2-year Associate and 4-year Bachelor degrees are driven to prepare students to be immediately productive to their employers. This is monitored each year through surveys and input from our advisory board. Since we are a 2 plus 2 programs, the first 2 years prepare students with fundamental hands on training regardless of students graduating and leaving for employment or continuing toward their Bachelor degree. See Appendix 14 for HVACR program check sheets.
    a. As part of both the 2-year and 4-year degrees are general education class (cultural enrichment and social awareness) requirements. As advisors we try to help students select these classes which will enhance their career choice. Most careers within the HVACR industry involve dealing with people and as such student need to expand their learning experiences of social interaction and cultural differences. In addition, both degrees require the University standards for English and Science.
    b. There are many prerequisites within both the 2-year and 4-year HVACR programs. Within the 2-year HVACR program student must pass (with a C- or better) HVAC101 & HVAC111 before enrolling in the other 100 level HVAC classes. Also, these students must pass all 100 level HVAC classes (with a C- or better) before enrolling into the 200 level classes. Additionally, 2-year students must take MATH116 (or MATH115) as a co-requisite to HVAC101 and HVAC111. This Math requirement is then a prerequisite (with a C- or better) to the other 100 level and 200 level HVAC courses. Within the 4-year HVACR program, the HVAC 300 and 400 level courses are all linked where students start with HVAC331 and HVAC342. These are then prerequisites to the other 300 level HVAC courses and all 300 level courses are prerequisites to the fall 400 level HVAC courses (HVAC415 & HVAC451). All of these courses are prerequisites to the capstone HVAC499 course. Additionally, MATH126 is a co-requisite to HVAC331 and HVAC342. This math course is then a prerequisite (with a C- or better) to the other 300 and 400 level HVAC courses.
    c. The HVACR program has other requirements which help to ensure our graduates are immediately productive as employees. Within the 2-year program the HVACR student must pass ISYS105 and COMM121. Both of these classes promote skill sets which are mandatory in the working world today. Within the 4-year HVACR program students must pass ARCH110 which is a mandatory skill set for any applied engineering technology career path today within the commercial building industry. Students within the 4-year HVACR program must also pass ECON221

and COMM221 which provide additional skill sets that are directly applicable to their employment.

2. Since the last program review the 2-year program has gone through a minor curriculum change where learning outcomes were slightly shifted in 100 and 200 level HVAC classes. This was done so we could increase the number of contact hours with students through lab experience without increasing overall credit hours. These changes were driven by input from our advisory board and faculty. Since the last program review the 4-year program has also undergone some changes related to shifting of learning outcomes within HVAC classes. The result of these changes created a new course HVAC350 and this was also driven by input from our advisory board and faculty. So far the result of these curriculum changes has been extremely positive and is reflected in our survey data.
3. There has been discussion among faculty and advisory board members to integrate BIM (Building Information Modeling) into the HVAC curriculum; however, there are no definite plans at this time as to how this will be completed. Additionally, there has been discussion to split HVAC331 into two distinct courses because HVAC331 was created when FSU went to semesters and this class combined two different classes which use to be taught in quarters. As this course is a fundamental system design course and our industry has evolved in recent years, there is more material than time to complete all learning outcomes in this class as it currently stands. At this time the faculty are still discussing the possibilities of modifying this class, but no defined plans have been created.
4. Plans for any revisions beyond what has already been stated have not been defined due to the previously stated faculty overload and steady enrollment. If the HVAC program were to get an additional tenured-faculty position we would have the luxury to plan for further revisions (certificate programs, integrated courses, expanded summer programs, etc…).

G. Quality of Instruction

1. As indicated in section 2 of this report, the alumni give the HVACR program instruction very high marks and speak very favorably of the core HVACR courses. They felt the faculty advising was very important and faculty members were a great asset to the HVACR program. The current students indicated similar outcomes and spoke highly of HVACR faculty. Both groups had mixed results related to courses and instruction outside of the HVAC curriculum.
2. The advisory board survey results (section 2 of this report) indicate both for the 2-year and 4-year HVACR programs provide excellent training and learning environments for students due to the superior facilities within the Granger building, the highly experienced and passionate faculty, and hands-on training students receive at all levels. It is noted that the advisory board recognizes the need for another tenured-faculty such that the HVACR program can grow. Employers also recognized that graduates are ready day one due to excellent technical and hands-on learning. However, employers also noted that graduates could have better communication skills. This is why several of the HVACR faculty stress written work and why two of our 400 level HVAC courses are WIC defined.
3. The HVACR program does not have graduate assistants, but we do enjoy the finest learning environment for HVACR in North America. The HVACR labs are continually being

updated via donations and additions (we have received some Perkins funding). The HVACR computer labs were recently updated with new computers and software. Faculty are continually looking to improve their classes with new technology and hands-on learning experiences.

4. HVACR faculty are active in some form of professional development. Many of the faculty attend at least one continuing educational experience each year. And some of the faculty participate on campus in the Faculty Learning Center events. Most of the faculty within the HVACR program either teach on-line or use the on-line platform in a blended experience for on campus students. All faculty try to stay integral to industry advances in technology.
5. The HVACR program has a rich history of interacting students with faculty outside of the classroom as we have three HVACR industry related RSO groups and each has at least one faculty advisor. All three of these RSO groups also participate in national events where students and faculty travel to participate, grow and gain invaluable contacts for the future. Several of these student RSO groups have been either nationally recognized by their respective industry organization or the faculty advisory has been recognized for special services and achievements. One of these student RSO groups has been recognized at an international level more times than any other University in the world.
6. Due to the increased level of transfer students (both on-campus and on-line) the classrooms within the HVACR curriculum have seen a greater percentage of diversity (as defined by race – refer to section 3A for data). This has created a wider breathe of learning in classroom discussion and has given students a great perspective to the learning.
7. Due to items 5 and 6 above, the HVACR faculty have been integrated into a global experience of technology and students. Since most of the HVACR faculty are also experienced with on-line teaching, the global technology demands have been a easier challenge to keep student engaged in learning outcomes while utilizing the assets of the Granger building.

H. Composition and Quality of Faculty

1. The following are names, rank and qualifications of all tenured and tenure-track faculty in the HVACR program.
    a. HVACR Tenured Faculty
        i. John Tomczyk, Professor, M.S., 21 years, tenured
        ii. Michael Fuetz, Professor, Ph.D., 15 years, tenured
        iii. Michael Korcal, Associate Professor, M.S., 12 years, tenured
        iv. J. Eric Quilitzsch, Associate Professor, M.S., 11 years, tenured
        v. Douglas Zentz, Associate Professor, M.S., 10 years, tenured
        vi. Joseph Compton, Associate Professor, M.S., 9 years, tenured
        vii. Joseph Pacella, Associate Professor, M.S., 7 years, tenured
        viii. Brian Holton, Assistant Professor, M.S., 5 years, tenured
    b. Since the last program review five (5) faculty have obtained their tenure, and seven faculty have received promotions in rank. One faculty member has received merit at the professional level.

c. Professional activities since the last review include many items; here is a recap of many of these activities.
    i. John Tomczyk authored over 60 technical articles on Refrigeration, has been an Advisory Board member for HVAC Excellence, a member of two professional societies, has presented professionally four (4) times, and continues to be the lead author in a nationally recognized HVACR textbook used throughout North and Central America.
    ii. Michael Fuetz was program chair from 2006 to 2009, administered Federal Earmark Grants for our HVAC On-line delivery program, has been the faculty advisor to the MSCA student RSO and assisted students in attending yearly MSCA professional events, has been named MSCA HVACR Instructor of the Year, has been a board member for several outside professional organizations, developed HVACR curriculum for the HVACR program, completed his Ph.D. Educational Leadership, concentration in Career and Technical Education, has authored HVACR industry related educational material, and has presented professionally six (6) times.
    iii. Michael Korcal attended several professional society conventions, has authored educational material for professional organizations, has given multi-day workshops on Energy Auditing, has received his CEM (Certified Energy Manager) certification, was a part of the Ferris Rebuild America team with the DOE, and has presented professionally seventeen (17) times
    iv. J. Eric Quilitzsch has been the advisor to the ASHRAE student RSO and has led them on many activities including travel to annual conventions, has been the administrator for servers delivering online software and lectures to all HVAC BS courses, has served on pilot committees for on-line curriculum delivery, and has presented professionally five (5) times.
    v. Brian Holton has attended several professional society conference and technical workshops, was a key instructor and program developer for technical education through Ferris Corporate Professional Development, has been a key participant in the Ferris Rebuild America team with the DOE and authored the research documentation for this endeavor, and has presented professionally three (3) times.
    vi. Douglas Zentz has attended professional society conventions and conferences yearly, has been an officer for all 6 years in ASHRAE, sits on the ASHRAE society committee for student activities, has mentored six (6) internationally recognized award winning student competition teams, has been appointed coordinator to the HVACR in 2010 to 2012, has presented professionally nineteen (19) times, and has recently been named "Distinguished Lecturer" by ASHRAE.
    vii. Other faculty have been very active but did not submit documentation at the time of this document creation.

2. Since 2006 many of the HVACR faculty have been on overload schedules. The normal load is 12 credits or 18 contacts per semester or 24/36 per school year.

a. The following illustrates the percentage of load for each faculty for the fall of 2010, 2011, and projected for 2012.

Faculty	2010	2011	2012
Mike Feutz	100%	133%	133%
Mike Korcal	144%	72%	100%
J.Eric Quilitzsch	83%	117%	150%
Joseph Pacella	133%	144%	150%
Joseph Compton	133%	100%	100%
John Tomczyk	100%	100%	100%
Brian Holton	133%	89%	100%
Douglas Zentz	156%	75%	92%

It should be noted that when a faculty has a load under 100% in the fall their spring load was over 100%.

b. Currently Doug Zentz is given 25% release time for performing the HVACR program coordinator duties. It should be noted that when this position was termed a "chair" position the release time was 75%, please refer to section 5 for comment on this change and its affect on the HVACR program.

3. Recruitment for new faculty is normally facilitated through national publications, local industry related publications, Ferris website posting, and other related industry communication media.
   a. Applicants are reviewed by faculty, and the top candidates are invited to campus where they spend a day here at Ferris. Their experience includes a one hour discussion with faculty, a 10 minute academic presentation to faculty and tour of the HVACR facilities within the Granger building.
   b. Typically new faculty candidates must have a minimum of 5 years of related industry experience, a Bachelor degree in a related field of study and a Master degree in sometime which could be applied to the total learning experience. Prior teaching experience is a plus.
   c. Beyond the university diversity goals the only goal of the HVACR program is to potentially recruit a female faculty such that student recruitment of female students may be easier.
   d. At this time we have made contact with female alum to see if there is potential of trying adjunct teaching in the near future.
4. All new faculty attend faculty orientation sessions offered by the university during their first year at Ferris. These sessions provide teaching techniques and how to operate in the on-line environment. All new faculty are assigned a tenured faculty member as a mentor. New faculty are not assigned advisees during their first year so they may concentrate on teaching.
5. Reward Structure

a. There is no reward structure in the college or department. Exceptional teachers may apply for promotion or merit raises. Professional Development and travel funds are available to all faculty as funds permit. Faculty are encouraged to apply and seek professional development annually.
b. The existing salary structure definitely limits the ability of the program to recruit new faculty. Salaries offered typically are less than current faculty members receive and significantly less than a candidate may be earning in the private sector. Therefore it is difficult to attract highly experienced professionals. New faculty are likely to be young and less experienced.
c. There is no reward structure to support faculty productivity; however, the HVACR program has an endowment which provides additional funding for faculty development and productivity.
d. There is no reward structure related to diversity.

6. Graduation Instruction: The HVACR program currently has no graduate instruction.
7. Non-Tenure-Track and Adjunct Faculty
    a. Since the last review the HVACR program has had Bob Persons as an adjunct instructor.
    b. Bob Persons usually has a teaching load which ranges between 75-100% of a normal faculty load. His range of courses include Electricity, Gas and Oil Heating, Steam Heating Systems, piping, hydronics and boilers.
    c. Bob is a great fit for the HVACR program as he was a member of the Ferris physical plant for years and has more than 40 years of industry experience. Bob has personal experience with all forms of building heating systems and brings a practical sense of teaching to the students. Bob also has taught the high school HVAC program which has created a great source of potential students for our 2-year program.
    d. The HVACR program considers the use of adjunct faculty a great asset due to the difficulty in finding good experienced tenured track faculty willing to teach at Ferris.
    e. The HVACR program is currently not accredited.

I. Assessment and Evaluation

1. The HVACR Program has become involved with TracDat and have spent much time completing the documentation at the program and course level. Appendix 15 illustrates the actual learning outcomes for each of the HVAC classes.
2. The Associate Degree Program learning outcomes involve the proper installation, service, repair, and maintenance of HVAC equipment normally applied to residential and light commercial HVAC systems. These learning outcomes are assessed with lab tasks, exercises and typical classroom assessment exams, for more detail please refer to Appendix 16. The Bachelor Degree Program learning outcomes involve proper analysis, design, application, control, and energy management of HVACR systems in commercial buildings. These learning outcomes are assessed with lab tasks, exercises and typical classroom assessment exams, for more detail please refer to appendix 16.
3. The HVACR curriculum can be seen on our student check sheets. Appendix 14 contains the student program check sheets for both the 2-year Associate Degree and the 4-year

Bachelor Degree. Within each check sheet prerequisites are listed for each class and the curriculum is mapped out for students to follow as well as advisors. Each core HVAC class builds on the knowledge of the prior classes. The tables below illustrate the curriculum map for both the AAS and BS degree programs.

Curriculum Map - HVACR Technology A.A.S. -						
Legend: (I) Introduced, (M) Mastery, (R) Reinforced						
	Install	Service HVAC	Service Refrigeration	Troubleshoot Refrigeration	Troubleshoot HVAC	Design HVAC
HVAC 101			I			
HVAC 102			I	I		
HVAC 111	I					
HVAC 117	I	I			I	
HVAC 132	R	I			I	
HVAC 207			R, M	M		
HVAC 208	R	M			R	
HVAC 235	R,M	M				
HVAC 245						I, M

Curriculum Map - HVACR Engineering Technology B.S. -								
Legend: (I) Introduced, (M) Mastery, (R) Reinforced								
	Select System	Design System	Secondary Equipment Selection	Primary Equipment Selection	Commission	Energy Audit	HVACR Contracting Issues	Control
HVAC 312			I, M					
HVAC 331		I	I		I		R	
HVAC 342		I						
HVAC 350					R	R	I, M	
HVAC 362	I	I	R	I		R	R	R
HVAC 393	R	R		R	R	R	R	R
HVAC 415			R		M	R		M
HVAC 451			R		M	R		M
HVAC 499	M	M	M	M	R	R	R	R

4. The following summarizes the assessment means listed for courses and a summary of results. Please refer to Appendix 16 for reference to TracDat Analysis.
    a. Associate Degree Measured Learning Outcomes
        i. Test, internally developed, pre/post or post (includes quiz's and exam's)
        ii. Lab assignment; faculty will assess student in the laboratory setting
        iii. Lab project; student will complete a lab project associated with the learning outcome (HVAC design course)
        iv. Performance (lab exam); faculty will assess student in the laboratory setting
        v. Written product; lab reports
        vi. Oral presentation (rubric based scoring)
    b. The criterion for success in each course level assessment is 80%. Most classes are meeting or exceeding this criterion. For the very few which are not meeting this criterion action plans within TracDat are being implemented to gain the 80% criterion level for success.
    c. Bachelor Degree Measured Learning Outcomes
        i. Test, internally developed, pre/post or post (includes quiz's and exam's)
        ii. Visual Display, HVAC 312: student will demonstrate knowledge of control terminology by identifying control components of commercial systems. Information transferred to a drawing demonstrating knowledge of definition, function, and location.
        iii. Lab assignment; problem based assignments

   iv. Lab project; student will participate in a lab exercise based on the task/s associated with the learning outcome.
   v. HVAC 350, Semester Project: student will work on a semester project based on a real set of conditions for system selection, sizing and application based on all course outcomes. Written report will contain explanations, calculations, spec. sheets, diagrams, schematics, and equipment schedules.
   vi. Written product; lab reports or exercises
   vii. Oral presentation (rubric based scoring)
   viii. HVAC 499, Survey: rubric used by a student's team members as peer evaluation for performance. Rubric used to evaluate the student's team performance.
  d. The criterion for success in most course level assessment is 80%. The exceptions include HVAC 312 criterion from 75% for exams to 90% for lab exercises or assignments, plus HVAC 451 oral presentations at 90% criterion. Most classes are meeting or exceeding this criterion. For the very few which are not meeting this criterion action plans within TracDat are being implemented to gain the stated criterion level for success.

5. Learning outcomes at the program level measured by the following means:
  a. Academic Program Review surveys
  b. Feedback received from advisory committee members during the twice-yearly meetings
  c. Information received from employer reports of intern performance
  d. Analysis of How Students are Meeting Program Level Outcomes: Survey results are based on competencies and skills related to the program level learning outcomes but there are no survey questions that are worded the same as the program level outcomes. This is an area for improvement. Survey questions need to match Tracdat, program level, learning outcomes if there is a requirement to enter results in Tracdat and report on results in program reviews.
  e. Analysis of 2012 AAS graduate survey results related to program level, learning outcomes based on the responses to the section titled preparation. Survey selections in the preparation section were; very well prepared, well prepared, fairly prepared, barely prepared, and poorly prepared.
   i. Outcome: Install: Students will demonstrate installation techniques for residential and light commercial HVAC systems.
    1. No survey questions provide a basis of analysis.
   ii. Outcome: Service HVACR: Students will service residential and light commercial HVAC equipment.
    1. 1st Survey topic providing analysis; Commercial Air Conditioning
     a. 43.8% very well prepared, 35.4% well prepared, 16.7% fairly prepared, 2.1% barely prepared, 2.1% barely prepared
     b. Survey results show a majority of graduates have a positive perception of their preparation for this topic.
    2. 2nd Survey topic providing analysis; Oil (heating with fuel oil)

a. 29.2% very well prepared, 22.9% well prepared, 27.1% fairly prepared, 14.6% barely prepared, 2.1% poorly prepared
b. Survey results show 52.1% of graduates have a positive perception of their preparation for this topic.

3. 3rd Survey topic providing analysis; gas (heating with gas)
    a. 33.3% very well prepared, 37.5% well prepared, 18.8% fairly prepared, 6.3% barely prepared, 0% poorly prepared
    b. Survey results show 70.8% of graduates have a positive perception of their preparation for this topic.
4. 4th Survey topic providing analysis; electrical
    a. 45.8% very well prepared, 35.4% well prepared, 12.5% fairly prepared, 6.3% barely prepared, 0% poorly prepared
    b. Survey results show 81.2% of graduates have a positive perception of their preparation for this topic.

iii. Outcome: Troubleshoot HVAC: Students will systematically troubleshoot and repair residential and light commercial HVAC equipment.
    1. Analysis: no survey questions provide a clear basis for analysis. The best available data is identical to the information shown for service air conditioning.

iv. Outcome: Service Refrigeration: Students will service commercial refrigeration equipment.
    1. Analysis: Survey topic providing analysis; Commercial Refrigeration
    2. 37.5% very well prepared, 35.4% well prepared, 20.8% fairly prepared, 4.2% fairly prepared, 0% barely prepared.
    3. Survey results show 72.9% percent of graduates have a positive perception of their preparation for this topic.

v. Outcome: Troubleshoot Refrigeration: Students will systematically troubleshoot and repair commercial refrigeration equipment.
    1. Analysis: no survey questions provide a clear basis for analysis. The best available data is identical to the information shown for service refrigeration.

vi. Outcome: HVAC Design: Students will design residential and light commercial HVAC systems.
    1. Analysis: Survey topic providing analysis; Design HVAC
    2. 41.7% very well prepared, 37.5% well prepared, 18.8% fairly prepared, 2.1% fairly prepared, 0% barely prepared
    3. Survey results show 79.2% of graduates have a positive perception of their preparation for this topic.

f. Analysis of 2012 BS graduate survey results related to program level, learning outcomes. Survey selections in the preparation section were; strongly agree, agree, neutral, disagree, and strongly disagree.

i. Outcome: Select System: Students will analyze and select commercial and industrial HVAC systems for specific applications.
    1. Analysis: no survey questions provide a clear basis for analysis.

ii. Outcome: Design System: Students will design commercial and industrial HVAC systems, given design parameters, building type and geographic location.
    1. Survey topic providing analysis; Well prepared in the area of HVACR Design
    2. 60% strongly agree, 32% agree, and 4% disagree
    3. Survey results show 92% of graduates have a positive perception of their preparation for this topic.

iii. Outcome: Select Secondary Equipment: Students will select secondary equipment for specific commercial and industrial ducting and piping systems.
    1. 1st survey topic providing analysis; Well prepared in the area of equipment selection
        a. 48% strongly agree, 36% agree, and 16% neutral
        b. Survey results show 84% of graduates have a positive perception of their preparation for this topic.
    2. 2nd survey topic providing analysis; Equipment selection is an important part of your job
        a. 36% strongly agree, 28% agree, 24% neutral, 8% disagree, and 4% strongly disagree
        b. Survey results show 64% of graduates have a positive perception of the importance of this topic for their career.

iv. Outcome: Select Primary Equipment: Students will select primary equipment for specific commercial and industrial ducting and piping systems.
    1. Best available data would be the same as shown for select secondary equipment as there is no clear separation between Secondary and Primary Equipment.

v. Outcome: Commissioning: Students will commission a commercial or industrial HVAC system.
    1. 1st survey topic providing analysis; Ability to commission an HVAC system is an important part of your job.
        a. 56% strongly agree, 24% agree, 12% neutral, 4% disagree, and 4% strongly disagree
        b. Survey results show 80% of graduates have a positive perception of the importance of this topic for their career.
    2. 2nd survey topic providing analysis; Well prepared to commission HVAC equipment
        a. 24% strongly agree, 56% agree, 12% neutral, 4% disagree, and 4% strongly disagree
        b. Survey results show 80% of graduates have a positive perception of their preparation for this topic.

vi. Outcome: Energy Audit: Students will perform an energy audit of an actual facility and analyze utilities for proper application; Operation and

Maintenance (O & M) and Energy Conservation Measures (ECMs) for potential energy savings; and implementation feasibility using payback calculations.

1. 1st survey topic providing analysis; Energy audits are an important part of your job
    a. 28% strongly agree, 36% agree, 28% neutral, 8% disagree, and 0% strongly disagree
    b. Survey results show 64% of graduates have a positive perception of the importance of this topic for their career.
2. 2nd survey topic providing analysis; Well prepared to do an energy audit
    a. 28% strongly agree, 56% agree, 12% neutral, 4% disagree, and 0% strongly disagree
    b. Survey results show 84% of graduates have a positive perception of their preparation for this topic.

vii. Outcome: HVACR Contracting Issues: Students will understand, utilize and develop estimates, specs., economic cost analysis and codes and standards. Students will also understand the key duties of Project Management.

1. 1st survey topic providing analysis; Ability to read a blue print is an important part of your job
    a. 80% strongly agree, 12% agree, 4% neutral, 0% disagree, and 4% strongly disagree
    b. Survey results show 92% of graduates have a positive perception of the importance of this topic for their career.
2. 2nd survey topic providing analysis; Well prepared in area of blue print reading.
    a. 40% strongly agree, 28% agree, 16% neutral, 16% disagree, and 0% strongly disagree
    b. Survey results show 68% of graduates have a positive perception of their preparation for this topic Survey results show 68% of graduates have a positive perception of their preparation for this topic.
3. 3rd survey topic providing analysis; Ability to understand job specs is an important part of your job.
    a. 72% strongly agree, 16% agree, 4% neutral, 8% disagree, and 0% strongly disagree
    b. Survey results show 88% of graduates have a positive perception of the importance of this topic for their career.
4. 4th survey topic providing analysis; Well prepared to deal with job specifications.
    a. 36% strongly agree, 24% agree, 12% neutral, 20% disagree, 4% strongly disagree, and 4% not applicable

   b. Survey results show 60% of graduates have a positive perception of their preparation for this topic.

viii. Outcome: Control: Students will program control sequences for specific commercial and industrial HVAC systems and equipment.

1. 1st survey topic providing analysis; Control theory is an important part of your job
   a. 72% strongly agree, 24% agree, 0% neutral, 4% disagree, and 0% strongly disagree
   b. Survey results show 96% of graduates have a positive perception of the importance of this topic for their career.
2. 2nd survey topic providing analysis; Well prepared in the area of control theory
   a. 48% strongly agree, 48% agree, 4% neutral, 0% disagree, and 0% strongly disagree
   b. Survey results show 96% of graduates have a positive perception of their preparation for this topic.
3. 3rd survey topic providing analysis; Control application is an important part of your job
   a. 64% strongly agree, 28% agree, 4% neutral, 4% disagree, and 0% strongly disagree
   b. Survey results show 92% of graduates have a positive perception of the importance of this topic for their career.
4. 4th survey topic providing analysis; Well prepared in the area of control application
   a. 48% strongly agree, 36% agree, 12% neutral, 4% disagree, 0% strongly disagree
   b. Survey results show 84% of graduates have a positive perception of their preparation for this topic.

6. Assessments at the course and program level have created a closer tie of course material between HVAC courses. An example of this involves the use of a local commercial building for the HVAC342 (Load Analysis and Energy Modeling) and HVAC451 (Energy Audit and Analysis). We have now taken the same building with the same students from HVAC342 to HVAC451 to enhance the learning and reinforce the continuation of Bloom's Taxonomy to higher levels of student analysis and application.
7. Variables effecting program assessment include the following:
   a. Program efficacy assessed by means of employer, alumni, and advisory committee member surveys. Alumni survey data has been analyzed, summarized, and entered in the Tracdat system. Tracking the data provides information for determining if action is required to improve or modify program curriculum, learning outcomes, assessment means, or other related program delivery issues.
   b. Program efficacy assessed by means of individual course assessments. Some professors are using the Tracdat system and entering the results of assessments. Tracking the data provides information for determining if action is required to improve or modify course curriculum, learning outcomes, assessment means, or

other related course delivery issues. The efficacy of the individual courses is a key component of program efficacy.

c. Enrollment rates provide a general indicator of the health of the HVACR programs but do not provide clear evidence of the effectiveness of the program.

d. Degree completion compared to enrolment rates provide an indicator of student retention but do not provide clear evidence of the effectiveness of the program.

8. Trend Data for item & above.
   a. The trend data for survey and assessment results are included in the TracDat report included in section,3, I, item 5.
   b. The trend data for assessment results are included in the Tracdat report included in section,3, I, item 5.
   c. Fall Enrolment Data

Academic Year 2008-2009 2009-2010 2010-2011 2011-2012

Academic Year	2008-2009			2009-2010			2010-2011			2011-2012		
HVACR												
HVACR Engineering Technology BS	73	54		92	55		80	0	73	73		83
HVACR Technology AAS	63			59			65			60		
Pre-HVACR Engineering Technology BS	3			4			5			3		
Pre-HVACR Technology AAS	11			9			8			13		
PROGRAM LOCATION TOTAL	**150**	**54**	**0**	**164**	**55**	**0**	**158**	**0**	**73**	**149**	**0**	**83**
DEPARTMENT TOTAL	**204**			**219**			**231**			**232**		

   d. Degrees Conferred By Program

Academic Year 2008-2009 2009-2010 2010-2011

Academic Year	2008-2009				2009-2010				2010-2011			
HVACR												
HVACR Engineering Technology			31				45				50	
HVACR Technology		30				36				26		
TOTAL	0	30	31	0	0	36	45	0	0	26	50	0

9. Trend data is used to assess the rigor, breathe and currency of the program:
   a. Data that is trended and data that is analyzed but not necessarily trended are used to determine the following:
      i. What are the perceptions of alumni, employers and advisory committee members related to the rigor, breadth, and quality of the program and facilities
      ii. Are students meeting or exceeding the minimum performance criterion as established by the faculty and determined by course assessment means
      iii. Are jobs available and what types of jobs are available
      iv. Will employers hire the students
      v. Are employers satisfied with the students performance
      vi. Are there gaps in the curriculum as a result in changes in the industry or technology
      vii. Is the curriculum relevant to the needs of employers

   b. These topics are discussed in program meetings and the topic of casual conversations between program faculty.
10. Program goals are met as follows:
   a. Alumni survey data is used to determine if the curriculum is relevant and did the program prepare them for their career.
   b. Enrollment trend data is discussed during program meetings. A decrease in enrolment may indicate a need to focus on recruitment and review scholarship opportunities.
   c. A decrease in student retention rates may indicate a need for an improved orientation. This was the case with the on-line B.S. program and adjustments were made to improve student awareness of what to expect from the on-line courses.

J. Service to Non-Majors

1. The HVACR program does not provide any General Education services to the university or other programs at Ferris State University.
2. The HVACR program provides two courses (HVAC337 and HVAC483) to the Facilities Management and Architectural programs as required courses in their curriculum. HVAC337 is a broad overview of mechanical, electrical and plumbing systems within commercial buildings. HVAC483 covers HVAC, mechanical and electrical systems in more detail from an energy and management perspective. Both courses have incorporated minor updates as the focus of commercial building energy efficiency has increased. The HVAC program also provides HVAC337 to the Construction Management program as one of their required courses. This course has been slightly updated as the move to LEED certified buildings as increased. Inclusion of LEED elements and awareness of LEED requirements have been added.
3. Since the two programs (Architecture/Facilities Management and Construction Management) are within the same “School of Built Environment” as the HVACR program, the impact of servicing both programs has been minor or “no change” from the last HVACR program review.
4. The HVACR program does not plan at this time to change the level of service of our Non-Major courses. Based on enrollment of the other programs there is no significant need to change.

K. Degree Program Cost and Productivity Data

1. The following table illustrates the HVACR Student Credit Hours (SCH), Full Time Equated Faculty (FTEF), and SCH/FTEP Aggregated.

Academic Year	SCH	FTEF	SCH/FTEF
2006-2007	3,179	11.36	279.96
2007-2008	3,604	9.92	363.18
2008-2009	3,121	9.59	325.44
2009-2010	3,652	10.07	362.68
2010-2011	3,198	8.77	364.71

2. It should be noted that the College of Engineering Technology SCH/FTEF value of 380.99 and University value of 466.28 for 2010-2011 are higher than the HVACR program!

L. Administrative Effectiveness

1. As was seen in the faculty and advisory board surveys, there is a significant lack of support (staff, administrative, and college leadership) to the HVACR program. The College of Engineering Technology has been operating under an interim Dean for 2 years and financial support from the college has not changed much (it has actually decreased) in many years even though our enrollment has increased. These concerns were also echoed in the last Academic Program Review for the HVACR Program and this concerns the faculty and has limited our ability to grow as a program.
2. The HVACR program is not being run as effectively as it could be (as indicated in the faculty and advisory board surveys). This is directly a result of the current structure within the College of Engineering Technology. The head faculty only receives 25% release time for all administrative and department level responsibilities. This coupled with most faculty on overload schedules and strong enrollment leads to difficulties in maintaining proper department/program operation. This is compounded when the majority of our students are transfers and need the extra attention for admissions, advising, and graduation processing. The HVACR program enjoys a strong relationship with community colleges and vocational education centers and many of these educational facilities come to Ferris State University each year for tours and this demands time for effective recruitment.
3. The class scheduling and teaching loads have been managed well for many years. We currently have the program coordinator prepare the faculty load for each person and then have a software program which looks are the classes scheduling for all students to ensure students are being served in the most effective manner to avoid class scheduling conflicts with core required courses. If possible scheduling is modified to allow faculty to pursue outside activities for professional development.
4. Students are able to take classes in a timely manner as classes are scheduled in blocks where they can effectively complete their required courses on the program checks sheet and allow open time for elective courses and general education requirements. To effectively due this the HVACR program offers multiple sections of most core courses and some courses are offered both fall and spring semester.

Section 4 – Facilities and Equipment

A. Instructional Environment

1. The HVACR Programs have been housed in the Granger Center for Construction and HVACR since the Winter of 2004. Having been designed with the teaching of HVACR and Construction Management in mind, it remains one of the premier teaching facilities in the country and perhaps the world.
2. The classrooms within the Granger Center are well equipped and in fair shape for a 10 year old facility. There are maintenance items as would be expected and it is time for upgrading of audio visual equipment if the facility is to remain an example of the best we can offer. The laboratories are constantly changing as equipment and technology move in and out of lab stations as required by changes in industry. As is true with the classrooms;

the condition of the labs is typical of a ten year old facility needing periodic maintenance. The technology available to students of the HVACR programs is second to none, faculty and staff are continually working internally and externally to make the most current technology available to students; this is true of computers as well as HVACR specific equipment.

3. The Granger Center fills multiple roles impacting program delivery. First it is a marketing tool which is used to get prospective students excited about an education in HVACR. Next it is a home to students in the HVACR and CM programs; they have access, materials, technology, comfortable surroundings; all these things lead to a feeling of ownership and the Granger Center becomes a gathering place for all types of activities. Finally the facility is a living laboratory; it has amazing labs with specific examples of new and old technology but even more examples can be found throughout the building systems. There are many opportunities to step out of the classroom or lab and see real world examples of "The Built Environment" just down the hall.
4. The projected needs of the program with regard to the facilities will be dependent upon enrollment. The program is currently near capacity and has the room for only a small increase in enrollment. This has been the long term goal since the new facility was built and with the current number of faculty, and level enrollment no facilities are needed or planned for.
5. The only changes to current facilities would be due to improved technology in the future as it relates to student learning. Most of our students are "left brain" and this demands a more hands-on approach to learning. Therefore, if future advances in technology lead to enhanced learning there may be a need for facility modifications.

B. Computer Access and Availability

1. The hardware that is available to the program includes eighteen computer workstations located in Granger 260 and 270 plus the computers used in the main lecture rooms in Granger 117 & 119. The computers were replaced in the winter of 2010 as they had exceeded their useful life.
    i. Due to compatibility issues, software varies in the two main computer labs that have yet to be resolved. The students are required to use the following software for degree completion. The software included on the computers in lab is the Microsoft Office bundle of programs for word processing, database and spreadsheet creation and manipulation. In addition Microsoft Project and Visio and AutoCad are used regularly. Other program specific software packages that are used include the following:
        1. Carrier HAP (Building load and simulation software)
        2. Johnson Controls application programs
        3. Revit (Building Informational Modeling)
        4. Trane Trace (Building load and simulation software)
        5. Trane TOPPS (HVAC equipment selection software)
        6. Trane System Analyzer (Building HVAC simulation software)
        7. Trane Piping and ductwork design software

ii. Most of the software has an annual cost incurred to the HVACR department on a yearly or semester basis.
iii. The labs are available to our on-campus student's use during lab times and available for their use on the weekends or other times when the no classes are scheduled. In addition the online student must have access to the same program specific software packages. This has resulted in continued difficulty with the on campus and online students sharing the same computers for some applications that results in difficulty for both. Adjacent to both computer labs is a printing room with a plotter and a printer, the printer has exceeded its useful life and requires replacement.
iv. Outside of the computer labs are 13 workstations for general use in the public area of the building.

2. The resources are used for both HVACR AAS and BS degrees. The courses in the BS program and one course in the AAS program employ the use of the above computers with a minimum of 1 lab per section to 3 labs per section on a weekly basis. The AAS degree has other courses that use these labs as they are available for instruction. These rooms are in use virtually all day between and after scheduled class times as the much software available on the machines is not available on other computers across campus.
3. Industry partners have donated and updated many systems to insure student development. The Granger Center remains an excellent facility in which to teach of students in both the AAS & BS HVACR programs for the on campus student during scheduled class times. The same courses delivered online have complicated the usage of resources as they are typically requiring competition of the resources. Additional resources that would assist faculty is the ability to provide separate systems for our on campus and online students to have the opportunity to operate required software at their own schedule.
4. At this time the HVACR department has discussed the challenges within our Department and some Advisory board members. The HVACR department has not developed a complete plan to address all of the issues other than making the required software available to students using FSU's server space although this incurs a higher cost for implementation. No plan has been distributed to the department or college planning documents.
5. The on campus student is using FerrisConnect for most of the courses in some of the AAS & all of the BS programs. The effect that on course delivery is positive for both students and instructors. It acts as a medium to share information to students and provide a vehicle for various self-assessments for students, a vehicle for submission of work in electronic fashion and an active grade book for students. The on line student uses FerrisConnect (Blackboard 9.1) for all HVACR classes. The mandatory conversion to this system is in process by each instructor for their individual courses.
6. Computer support has been an issue with our on campus students. Numerous issues have been experienced recently in computer labs in Granger 260 & 270. Most of the issues have been related to software compatibility between HVACR specific programs and the challenge to complete the installation of the software. Computer hardware issues occasionally are present and prompt complete repairs have been also challenging. Other

concerns include software updates on computers and re-imaging (software restoration)of the computers that have not been communicated to the faculty. Online support is sometimes difficult with computer software that is not supported by the Technology Assistance Center (TAC). Most occasions the student works with the instructor to insure proper connectivity.

C. Other Instructional Technology

1. The HVACR curriculum lends itself to exercises built on real world examples. The HVACR Industry is an industry immersed in changing technologies. Combine these two ideas and we find that the courses within the HVACR program require a wide variety of technologies to serve as examples for lecture and laboratory exercises. Many of the instructional technology components exist within the construct of the Granger Center. The classrooms and computer labs have audio visual stations that allow the instructor to share computer images, DVD, audio, VHS, and hi-res camera sources with the students via a projector. Additionally many of these rooms have the ability to capture handwritten annotations on the images projected. These stations are certainly more advanced than some that might be found around campus, but if the Granger Center is to remain a premier facility, the audio visual equipment will need to be updated soon. Changes in computer technology will necessitate the upgrade of the building equipment as we use different types of media. For example, most of the current stations use a 4:3 aspect ratio and have VHS Tape players built in while new computers and monitors are shipping with a wider aspect ratio and VHS Tape is not a commonly used media.
2. The individual labs will also have a continuing need for instructional technology in the form of simulator panels or actual lab equipment. In some cases this equipment will need to be updated frequently so that students learn on current technology; temperature controls is such an area and through industry support we have installed 16 student stations plus 2 real world example systems with current temperature control technology. Other subjects may require both current and older technologies so that students can learn to function in a service industry where not everything is new. Each faculty member is active in soliciting donations for equipment to be used as instructional tools within the areas they teach and try to maintain a relevant mix of examples so the students will be well prepared. These lab equipment donations are continually sought and should be expected to remain an area of flux.
3. The Granger Center mechanical and electrical systems also serve as a great source for instructional technology. The facility was built as a teaching tool and most systems that would be hidden from view in a typical building are exposed and available to occupants of Granger. These types of examples are not in a state of constant change like the lab equipment and test panels but they provide a true example of HVACR, construction and maintenance in a commercial facility.
4. When examining an application in the HVACR industry, students will be shown examples of equipment, calculations, charts, and etcetera. These examples may be real objects or audio visual materials. Many times the application will have such a large number of variables and possible outcomes that the student will need to move on to a practical exercise using the actual object, or a test panel. This practice provides an assurance from

first hand knowledge and builds confidence. All of the HVACR courses follow a “hands on” approach and require continuous support in the form of HVACR specific instructional technology as well as standard computer and audio visual technology. The classroom and computer lab equipment is in need of updating and there is a committee working on proposals this year. Funding is already available within HVACR and CM programs for all reasonable requests via moneys left over from the original construction.

5. Overall the facility resources are still in good shape; the building is approximately 10 years old. Computers have been replaced, projectors have been maintained and in some cases replaced, lab equipment is constantly changing. The HVACR programs will often identify a need from industry and go in search of a donor. That process in most cases has proven very effective; it is the facility equipment that is more difficult to upgrade and keep current. While our industry partners move fast in everything they do, our internal functions run by committee and it will probably take more time and effort to get the VHS players replaced with streaming media players than it will to get the next control lab donation. We need to maintain the ability within individual programs to install technology that is correct, not just “the standard”.

D. Library Resources

1. The library resources available through FLITE support the HVACR programs very well. Students in both traditional setting as well as distance learning students have access to HVACR and Engineering specific documents and data via the FLITE database. Publications from professional organizations in HVACR, Mechanical and Electrical Code, all relevant standards can be accessed locally or on-line. We have periodic contact with our FLITE liaison and have opportunity to discuss materials and subscriptions that will be available to students and faculty alike.
2. The FLITE staff have been able to accommodate faculty teaching FSUS 100 courses as well as holding special HVACR program training so that faculty know how to properly use resources that are available. There are no known issues with support.
3. The budget allocated to HVACR specific resources has been adequate and we have had opportunity to discuss cost versus value for the subscriptions that are provided.

Section 5 – Conclusion

A. Relationship to Ferris State University Mission
   a. The HVACR Program mission is directly aligned with the FSU mission as the HVACR program provides a practical, career-oriented education that leads to practical employment worldwide. This is continually reinforced each year through internships and nearly 100% graduate employment within 3 months of graduation.

B. Program Visibility and Distinctiveness
   a. The FSU HVACR program has a reputation as the leading HVACR educational institution in the HVACR field. This is based on the continued success of students in both the 2-year and the 4-year degree programs as student are annually recognized with industry awards, scholarships, society chapter and student recognition. Since moving into the Granger building, the HVACR program has been recognized by many industry organizations as the

leading facility in HVACR education, this is continually reinforced when visitors come for graduate recruitment.

b. The HVACR program enjoys a uniqueness not found in many programs at FSU. The HVACR program transitioned the last 2 years of the Bachelor Degree to On-line delivery and we will be starting our 11th Cohort of On-line students this fall. Each of these on-line cohorts has students from almost anywhere; we have had in one cohort a student living in San Diego and another living in Saudi Arabia taking the class at the same time. This uniqueness brings high visibility to the HVACR Bachelor program, but at the same time brings a high level of stress and demand to the program as a very large segment of potential students approach the HVACR program for admission. More than 95% of these students are transfer students where it is very time consuming to review transcripts and help students through the admissions process. When the lead faculty was a “chair” and received 75% release time, this assigned responsibility was handled (although time consuming). Now that the led faculty is a “coordinator”, this assigned responsibility is extremely difficult and at times unmanageable. It is the recommendation of the HVACR faculty that the “chair” position be reinstated with the appropriate release time.

C. Program Value

a. The FSU HVACR program has enjoyed strong enrollment (as illustrated in section 3) and the projected fall 2012 enrollment is over 220 students. This represents a significant percentage of total students enrolled in the College of Engineering Technology and is one of only a few programs in the college where enrollment has either remained steady or shown growth in the last five (5) years. The HVACR SCH/FTEP value is lower than the college average and much lower than the university average.

b. Due to our new college structure, the HVACR program is now an integral part of the “School of Built Environment” and we are led by Brian Craig, the Director of this school. Brian is an Architect by trade and brings a different perspective to the HVACR program, curriculum and faculty. His input has been well received and his perception of the HVACR program is expressed in appendix 17.

D. Enrollment

a. Enrollment in the HVACR program continues to be strong. Faculty has considered adding another section of on-line students to our 4-year on-line degree offering, but at our current faculty load this would not work as we move new cohorts through the on-line program. The HVACR program has been operating at approximately 0.8 FTE (including the adjunct instructor and only 25% release time for the program coordinator). Thus, enrollment is about at our maximum without either adding another adjunct instructor or another tenured faculty position.

E. Characteristics, Quality and Employability of Students

a. AAS (2-year) students are typically from Michigan, but the HVACR program is experiencing some enrollment of students from outside of Michigan. The BS (4-year) students are coming from all parts of North America and even some international students are now coming from outside North America. The percentage of non-Michigan students is climbing to over 50% (this has been driven by the on-line program). Also there is a good mix of traditional and non-traditional students within the HVACR program. ACT scores for incoming freshmen have risen slightly over the past several years. Most students who do not succeed fail due to poor math skills and usually leave the HVACR program before their sophomore year. The increase in BS (4-year) program has dramatically increased the number of transfer students and this at times creates challenges for some students (admissions, graduating on-time, financial aid, etc…). Students completing their AAS degree usually have multiple job offers as there are more companies looking for service technicians than the number of graduates each year. Students completing their BS degree usually find employment prior to graduation; students in the upper half of each class usually obtain multiple offers for employment.

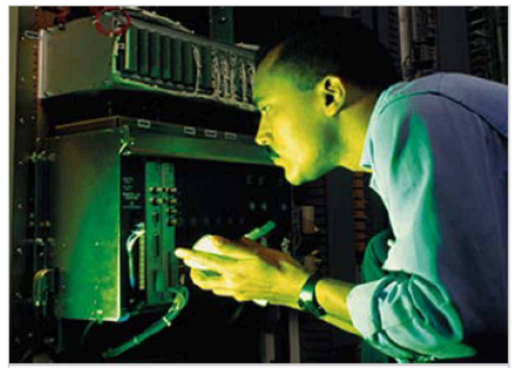
F. Quality of Curriculum and Instruction
   a. The curriculum has been recognized by professional organizations and fortune 500 companies in the HVACR field as being of high quality with a unique educational experience for graduates. The curriculum has also demonstrated its effectiveness in head to head student competition with engineering and technology based schools from around the world since 1997 where the FSU HVACR students have won (or placed) more times than any other school in the world.
   b. Since the inception of the FSU HVACR program the curriculum has always tried to maintain a leading edge to industry technology and practices to stay abreast of new developments within the HVACR industry. At this time faculty are again looking to continue this rich history and is why the curriculum is being analyzed again for new improvements. At this time new improvements being analyzed include:
      i. Due to the increasing integration of computer applications to equipment and communication devices, the 2-year program may need a new “computer applications” class where a wide range of newer computer applications could be taught with specific applications to the Service Technician career path. This is currently being analyzed as to the merit and depth of content worthy of a 2 or 3 credit course.
      ii. The integration of BIM (Building Information Modeling) into the HVACR curriculum where students can gain a real world example of this powerful tool for total building analysis. This learned skill has been supported by our advisory board, intern employers, and industry people that faculty interface with on a regular basis.
      iii. The addition of a new HVAC 300 level class such that fundamentals of air and water fluid principles, heat transfer, system design, and fluid balancing can be taught to a greater degree of depth and hands-on application. This is critical to many of the other HVAC courses and is driving the future of High Efficiency Buildings and Energy Management within Buildings.

G. Composition and Quality of the Faculty
   a. The faculty members are primarily full-time tenured individuals who are involved in professional organizations, consulting, professional speakers, continuing education and authorship. All faculty are recognized by industry as leaders in our industry.
   b. All faculty have “real world” working experience and carry this experience into the classroom. The average HVACR faculty brings close to a combined 30 years of industry and teaching experience into the classroom.

Heating, Air Conditioning, and Refrigeration Mechanics and Installers

Summary

Quick Facts: Heating, Air Conditioning, and Refrigeration Mechanics and Installers	
2010 Median Pay	$42,530 per year $20.45 per hour
Entry-Level Education	Postsecondary non-degree award
Work Experience in a Related Occupation	None
On-the-job Training	Long-term on-the-job training
Number of Jobs, 2010	267,800
Job Outlook, 2010-20	34% (Much faster than average)
Employment Change, 2010-20	90,300


HVACR technicians repair heating, cooling, and refrigeration systems.

What Heating, Air Conditioning, and Refrigeration Mechanics and Installers Do

Heating, air conditioning, and refrigeration mechanics and installers—often referred to as *HVACR technicians*—work on heating, ventilation, cooling, and refrigeration systems that control the air quality in many types of buildings.

Work Environment

Heating, air conditioning, and refrigeration mechanics and installers mostly work in residential homes, schools, hospitals, office buildings, or factories. Their worksites may be very hot or cold because the heating and cooling system they must repair is broken. Working in cramped spaces is common. Most work full time.

How to Become a Heating, Air Conditioning, or Refrigeration Mechanic and Installer

Because HVACR systems are increasingly complex, employers generally prefer applicants with technical training or those who have completed a formal apprenticeship. Some states and localities require technicians to be licensed.

Pay

The median annual wage of heating, air conditioning, and refrigeration mechanics and installers was $42,530 in May 2010.

Job Outlook

Employment of heating, air conditioning, and refrigeration mechanics and installers is expected to grow 34 percent from 2010 to 2020, much faster than the average for all occupations. Rising demand for trained technicians will result in excellent employment opportunities.

Similar Occupations

Compare the job duties, education, job growth, and pay of heating, air conditioning, and refrigeration mechanics and installers with similar occupations.

O*NET

O*NET provides comprehensive information on key characteristics of workers and occupations.

Contacts for More Information

Learn more about heating, air conditioning, and refrigeration mechanics and installers by contacting these additional resources.

OCCUPATIONAL OUTLOOK HANDBOOK

Construction and Extraction >

Construction and Building Inspectors

Summary

Quick Facts: Construction and Building Inspectors	
2010 Median Pay	$52,360 per year $25.18 per hour
Entry-Level Education	High school diploma or equivalent
Work Experience in a Related Occupation	More than 5 years
On-the-job Training	Moderate-term on-the-job training
Number of Jobs, 2010	102,400
Job Outlook, 2010-20	18% (About as fast as average)
Employment Change, 2010-20	18,400

Construction inspectors ensure that building codes are met through all phases of construction.

What Construction and Building Inspectors Do

Construction and building inspectors ensure that new construction, changes, or repairs comply with local and national building codes and ordinances, zoning regulations, and contract specifications.

Work Environment

Construction and building inspectors spend considerable time inspecting construction worksites, alone or as part of a team. Some inspectors may have to climb ladders or crawl in tight spaces. Most work full time during regular business hours.

How to Become a Construction or Building Inspector

Most employers require construction and building inspectors to have at least a high school diploma and considerable knowledge of construction trades. Construction and building inspectors typically learn informally on the job. Many states and local jurisdictions require some type of license or certification.

Pay

The median annual wage of construction and building inspectors was $52,360 in May 2010.

Job Outlook

Employment of construction and building inspectors is expected to grow 18 percent from 2010 to 2020, about as fast as the average for all occupations. Concern for public safety and a desire to improve the quality of construction are expected to spur employment growth. Those who are certified and can perform a variety of inspections should have the best job opportunities.

Similar Occupations

Compare the job duties, education, job growth, and pay of construction and building inspectors with similar occupations.

O*NET

O*NET provides comprehensive information on key characteristics of workers and occupations.

Contacts for More Information

Learn more about construction and building inspectors by contacting these additional resources.

Construction Managers

Summary

Quick Facts: Construction Managers	
2010 Median Pay	$83,860 per year $40.32 per hour
Entry-Level Education	Associate's degree
Work Experience in a Related Occupation	More than 5 years
On-the-job Training	None
Number of Jobs, 2010	523,100
Job Outlook, 2010-20	17% (About as fast as average)
Employment Change, 2010-20	86,600


Construction managers supervise a project from start to finish.

What Construction Managers Do

Construction managers plan, coordinate, budget, and supervise construction projects from early development to completion.

Work Environment

Although many construction managers work from a main office, most work out of a field office at the construction site where they monitor the project and make daily decisions about construction activities. Approximately two-thirds of construction managers were self-employed in 2010.

How to Become a Construction Manager

Employers increasingly prefer candidates with both work experience and a bachelor's degree in a construction-related field. However, some construction managers may qualify by working many years in a construction trade. Certification, although not required, is becoming increasingly important.

Pay

The median annual wage of construction managers was $83,860 in May 2010.

Job Outlook

Employment of construction managers is expected to grow 17 percent from 2010 to 2020, about as fast as the average for all occupations. Job opportunities will be best for candidates with work experience and a bachelor's degree in a construction-related field.

Similar Occupations

Compare the job duties, education, job growth, and pay of construction managers with similar occupations.

O*NET

O*NET provides comprehensive information on key characteristics of workers and occupations.

Contacts for More Information

Learn more about construction managers by contacting these additional resources.

Cost Estimators

Summary

Quick Facts: Cost Estimators	
2010 Median Pay	$57,860 per year $27.82 per hour
Entry-Level Education	Bachelor's degree
Work Experience in a Related Occupation	None
On-the-job Training	None
Number of Jobs, 2010	185,400
Job Outlook, 2010-20	36% (Much faster than average)
Employment Change, 2010-20	67,500


Cost estimators read blueprints to prepare estimates.

What Cost Estimators Do

Cost estimators collect and analyze data to estimate the time, money, resources, and labor required for product manufacturing, construction projects, or services. Some specialize in a particular industry or product type.

Work Environment

Although cost estimators generally work in central offices, they often visit factory floors or construction sites. Cost estimators typically work under pressure and experience stress because of the need to meet deadlines. As a result, overtime is common.

How to Become a Cost Estimator

A bachelor's degree and related work experience are increasingly important for entering the occupation. However, some highly experienced construction workers with analytical abilities may qualify without a bachelor's degree.

Pay

The median annual wage of cost estimators was $57,860 in May 2010.

Job Outlook

Employment of cost estimators is expected to grow 36 percent from 2010 to 2020, much faster than the average for all occupations. Job opportunities should be good as cost-conscious firms increasingly rely on cost estimates.

Similar Occupations

Compare the job duties, education, job growth, and pay of cost estimators with similar occupations.

O*NET

O*NET provides comprehensive information on key characteristics of workers and occupations.

Contacts for More Information

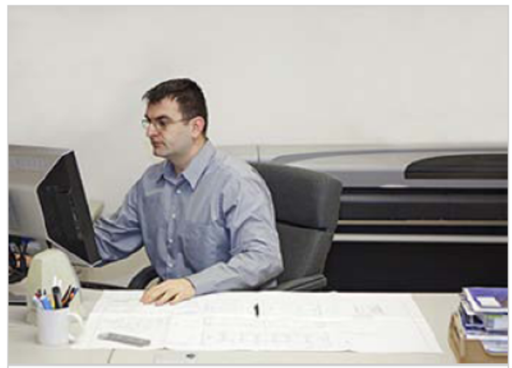
Learn more about cost estimators by contacting these additional resources.

OCCUPATIONAL OUTLOOK HANDBOOK

Mechanical Engineers

Summary

Quick Facts: Mechanical Engineers	
2010 Median Pay	$78,160 per year $37.58 per hour
Entry-Level Education	Bachelor's degree
Work Experience in a Related Occupation	None
On-the-job Training	None
Number of Jobs, 2010	243,200
Job Outlook, 2010-20	9% (Slower than average)
Employment Change, 2010-20	21,300


Mechanical engineers design and test equipment and machines of all types.

What Mechanical Engineers Do

Mechanical engineering is one of the broadest engineering disciplines. Mechanical engineers design, develop, build, and test mechanical devices, including tools, engines, and machines.

Work Environment

Mechanical engineers generally work in professional office settings. They may occasionally visit worksites where a problem or piece of equipment needs their personal attention. Mechanical engineers work mostly in engineering services, research and development, manufacturing industries, and the federal government.

How to Become a Mechanical Engineer

Mechanical engineers need a bachelor's degree. A graduate degree is typically needed for promotion into managerial positions. Mechanical engineers who sell services publicly must be licensed in all states and the District of Columbia.

Pay

The median annual wage of mechanical engineers was $78,160 in May 2010.

Job Outlook

Employment of mechanical engineers is expected to grow 9 percent from 2010 to 2020, slower than the average for all occupations. Job prospects may be best for those who stay abreast of the most recent advances in technology.

Similar Occupations

Compare the job duties, education, job growth, and pay of mechanical engineers with similar occupations.

O*NET

O*NET provides comprehensive information on key characteristics of workers and occupations.

Contacts for More Information

Learn more about mechanical engineers by contacting these additional resources.

OCCUPATIONAL OUTLOOK HANDBOOK

Power Plant Operators, Distributors, and Dispatchers

Summary

Quick Facts: Power Plant Operators, Distributors, and Dispatchers	
2010 Median Pay	$65,360 per year $31.42 per hour
Entry-Level Education	High school diploma or equivalent
Work Experience in a Related Occupation	None
On-the-job Training	Long-term on-the-job training
Number of Jobs, 2010	55,900
Job Outlook, 2010-20	-2% (Little or no change)
Employment Change, 2010-20	-1,100

Power plant operators do rounds to check that equipment is working properly.

What Power Plant Operators, Distributors, and Dispatchers Do

Power plant operators, distributors, and dispatchers control the systems that generate and distribute electric power.

Work Environment

Most workers are employed full time, and many work rotating shifts, which can be tiring.

How to Become a Power Plant Operator, Distributor, or Dispatcher

Power plant operators, dispatchers, and distributors need a combination of education, experience, and extensive on-the-job training. Nuclear power reactor operators also need a license. Many jobs require a background check, and workers are subject to drug and alcohol screenings.

Pay

The median annual wage of power plant operators, distributors, and dispatchers was $65,360 in May 2010.

Job Outlook

Employment of power plant operators, distributors, and dispatchers is expected to experience little or no change from 2010 to 2020. Although electricity usage is expected to grow, advances in technology and increased energy efficiency are projected to result in a 2 percent decline in employment for the occupation. Despite this, because the workforce is aging, job prospects should be good for those with related training and good mechanical skills.

Similar Occupations

Compare the job duties, education, job growth, and pay of power plant operators, distributors, and dispatchers with similar occupations.

O*NET

O*NET provides comprehensive information on key characteristics of workers and occupations.

Contacts for More Information

Learn more about power plant operators, distributors, and dispatchers by contacting these additional resources.

FERRIS STATE UNIVERSITY
COLLEGE OF TECHNOLOGY
CONSTRUCTION DEPARTMENT
HVACR PROGRAMS

April 16, 2012

Dear Ferris AAS HVACR Graduate:

Ferris State University Could Enhance the HVACR Programs! We Need YOUR Input!

The University's Academic Program review Committee is reviewing our HVACR Programs. As a graduate of Ferris State University HVACR program, we need your viewpoint! The results of this review can range from increasing our programs' resources, to placing the program in a probationary status. This process requires your **input!**

The value of your diploma from FSU varies with time and is determined by the reputation of the HVACR Programs. You can help us to enhance the value of your degree by simply completing and returning the enclosed survey by **May 7, 2012**.

Note: The result of the last program review in 2000 resulted in a **new building for the HVACR Programs**, your input is taken very seriously by the university!

In advance, we thank you for your quick response.

Sincerely,

Douglas F Zentz
Associate Professor
HVACR Program Coordinator

Enclosed: AAS Graduate Survey

FERRIS STATE UNIVERSITY
HVACR Program Review
Graduate Perception of the HVACR Programs

AAS GRADUATE SURVEY

Please complete the following survey.

A. Education:
Name:_________________________________ Check the degree(s) earned at Ferris below:
HVACR AAS Year _______ HVACR BS Year _______ Other _________________

B. Current Location Information:
Home address (if it is incorrect) ____
Home Phone: ___________________________ Work Phone: ________________________________
Company Name: ____
Position Title: _____________________________
Company Address: ____
e-mail address: ____

C. Program Enhancements:
A. Is there an industry need to increase the number of students? Yes No
B. When you attended, were the class sizes to large (number of students per faculty)? Yes No
C. When was the last time you visited the HVAC building?____________________________

D. Initial Salary Range: (mark the box corresponding to your initial salary range)

❒ Below $20k	❒ $26k - $30k	❒ $36k - $40k	❒ $45k - $50k
❒ $20 - $25k	❒ $31k - $35k	❒ $41k - $45k	❒ Above $50k

E. Current Salary Range:

❒ Below $25k	❒ $31k - $35k	❒ $41k - $45k	❒ $51k - $60k
❒ $25 - $30k	❒ $36k - $40k	❒ $46k - $50k	❒ Above $60k

F. Career Avenue Which Most Closely Describes Your Daily Activities (check one):

❒ Estimating/Design	❒ Marketing/Sales	❒ Field/Shop Service
❒ Company Management/Ownership	❒ Lab Technician	❒ Application Engineer
❒ Controls	❒ Other (Describe)	

AAS GRADUATE SURVEY

G. Scientific and Technical topics for Your Career:

Please circle your choices in each of the two columns to the right of each topic

Relevance: Under this column, rate the relevance of the topic to your career using, 5 = Very important, 4 = Important, 3 = Relevant, 2 = Not Very Important, 1 = Unimportant

Preparation: Under this column, rate the preparation that you received from your HVACR program using, 5 = Very Well Prepared, 4 = Well Prepared, 3 = Fairly Prepared, 2 = Barely Prepared, 1 = Poorly Prepared.

Course Topic	**Relevance**	**Preparation**
Basic Refrigeration	5 4 3 2 1	5 4 3 2 1
Electrical	5 4 3 2 1	5 4 3 2 1
Commercial Refrigeration	5 4 3 2 1	5 4 3 2 1
Commercial Air Conditioning	5 4 3 2 1	5 4 3 2 1
HVAC Design	5 4 3 2 1	5 4 3 2 1
Oil	5 4 3 2 1	5 4 3 2 1
Gas	5 4 3 2 1	5 4 3 2 1
Controls	5 4 3 2 1	5 4 3 2 1
Psychrometrics	5 4 3 2 1	5 4 3 2 1
Math	5 4 3 2 1	5 4 3 2 1
English	5 4 3 2 1	5 4 3 2 1
Computer Skills	5 4 3 2 1	5 4 3 2 1
Communication Skills	5 4 3 2 1	5 4 3 2 1

H. Course Content and Mix

A. Does the program need more technical content?	Yes	No
B. Does the program need more social awareness courses?	Yes	No
C. Does the program need more cultural enrichment courses?	Yes	No
D. Does the program need more communication courses?	Yes	No
E. Does the program need more writing intensive courses?	Yes	No

Please use the area below to add any additional comments:

____

____

____

____

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FERRIS STATE UNIVERSITY
COLLEGE OF TECHNOLOGY
CONSTRUCTION DEPARTMENT
HVACR PROGRAMS

April16, 2012

Dear Ferris BS HVACR Graduate:

Ferris State University Could Enhance the HVACR Programs! We Need YOUR Input!

The University's Academic Program review Committee is reviewing our HVACR Programs. As a graduate of Ferris State University HVACR program, we need your viewpoint! The results of this review can range from increasing our programs' resources, to placing the program in a probationary status. This process requires your **input!**

The value of your diploma from FSU varies with time and is determined by the reputation of the HVACR Programs. You can help us to enhance the value of your degree by simply completing and returning the enclosed survey by **May 7, 2012**.

Note: The result of the last program review in 2000 resulted in a **new building for the HVACR Programs**, your input is taken very seriously by the university!

In advance, we thank you for your quick response.

Sincerely,

Douglas F Zentz
HVACR Program Coordinator
Associate Professor

Enclosed: BS Graduate Survey

FERRIS STATE UNIVERSITY
HVACR Program Review
Graduate Perception of the HVACR Programs

BS GRADUATE SURVEY

Please complete the following survey.

A. Education:
Name:______________________________ Check the degree(s) earned at Ferris below:
HVACR AAS Year _______ HVACR BS Year _______ Other ________________

B. Current Location Information:
Home address (if it is incorrect) ____
Home Phone: ________________________ Work Phone: _____________________________
Company Name: ____
Position Title: _____________________________
Company Address: ____
e-mail address: ____

C. Program Enhancements:
A. Is there an industry need to increase the number of graduates? Yes No
B. Should the number of faculty per students be increased? Yes No
C. When was the last time you visited the HVACR building?______________________________

D. Initial Salary Range: (mark the box corresponding to your initial salary range)

❒ Below $20k ❒ $26k - $30k ❒ $36k - $40k ❒ $45k - $50k
❒ $20 - $25k ❒ $31k - $35k ❒ $41k - $45k ❒ Above $50k

E. Current Salary Range:

❒ Below $30k ❒ $36k - $40k ❒ $46k - $50k ❒ $61k - $70k
❒ $31 - $35k ❒ $41k - $45k ❒ $51k - $60k ❒ Above $70k

F. Career Avenue Which Most Closely Describes Your Daily Activities (check one):

❒ Bidding/Estimating ❒ Marketing/Sales ❒ HVACR Design
❒ Company Management/Ownership ❒ Performance ❒ Control Engineering
❒ Control Application Engineer ❒ Other (Describe) ___________________________

BS GRADUATE SURVEY

Page 2

Respond to the following statements:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
	SA	A	N	D	SD	NA
1 The HVAC design courses are important to your job	5	4	3	2	1	NA
2 You were well prepared in the area of HVACR Design	5	4	3	2	1	NA
3 The use of CAD is important to your job	5	4	3	2	1	NA
4 You were well prepared in the area of CAD	5	4	3	2	1	NA
5 The ability to do a load calculation is important to your job	5	4	3	2	1	NA
6 You were well prepared in the area of load calculations	5	4	3	2	1	NA
7 Equipment selection is an important part of your job	5	4	3	2	1	NA
8 You were well prepared in the area of equipment selection	5	4	3	2	1	NA
9 Control theory is an important part of your job	5	4	3	2	1	NA
10 You were well prepared in the area of control theory	5	4	3	2	1	NA
11 Control application is an important part of your job	5	4	3	2	1	NA
12 You were well prepared in the area of control application	5	4	3	2	1	NA
13 The ability to read a blue print is an important part of your job	5	4	3	2	1	NA
14 You were well prepared in the area of blue print reading	5	4	3	2	1	NA
15 The ability to understand job specs is an important part of your job	5	4	3	2	1	NA
16 You were well prepared to deal with job specifications	5	4	3	2	1	NA
17 Math is an important part of your job	5	4	3	2	1	NA
18 You were well prepared in the area of math	5	4	3	2	1	NA
19 Written communication skills is an important part of your job	5	4	3	2	1	NA
20 You were well prepared in the area of written communications	5	4	3	2	1	NA
21 Verbal communication skills is an important part of your job	5	4	3	2	1	NA
22 You were well prepared in the area of verbal communication	5	4	3	2	1	NA
23 The ability to troubleshoot is an important part of your job	5	4	3	2	1	NA
24 You were well prepared in the area of troubleshooting	5	4	3	2	1	NA
25 Energy audits are an important part of your job	5	4	3	2	1	NA
26 You were well prepared to do an energy audit	5	4	3	2	1	NA
27 The ability to commission an HVAC system is important to your job	5	4	3	2	1	NA
28 You were well prepared to commission HVAC equipment	5	4	3	2	1	NA
29 Overall, you were well prepared for the job that you are doing	5	4	3	2	1	NA
30 The advising was adequate in the HVAC program	5	4	3	2	1	NA
31 The placement services were adequate at Ferris	5	4	3	2	1	NA
32 The mix of technical / social & cultural courses were adequate	5	4	3	2	1	NA
33 You had no problem finding a job after graduation	5	4	3	2	1	NA
34 You were able to be productive in your job right out of school	5	4	3	2	1	NA
35 There is a high demand for the HVACR - 4 year graduate	5	4	3	2	1	NA

BS GRADUATE SURVEY

In the space below, you can make detailed comments on the previous page of evaluation or add comments on specific program concerns including program strengths, weaknesses, areas for improvement, action required to achieve improvement, etc.

HVACR APR...AAS Graduates

Frequencies

Prepared by: Institutional Research & Testing, 05/12

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q1 Name	48	0			
q2_1 Degree(s) earned at Ferris: HVACR AAS	48	0	.88	1.00	.334
q2_2 Degree(s) earned at Ferris: HVACR BS	48	0	.25	.00	.438
q2_3 Degree(s) earned at Ferris: Other	48	0	.15	.00	.357
q2.a Other specified	48	0			
q3 Year earned HVACR AAS	48	0			
q4 Year earned HVACR BS	48	0			
q5 Home Address	48	0			
q6 Home Phone	48	0			
q7 Work Phone	48	0			
q8 Company name	48	0			
q9 Position Title	48	0			
q10 Company Address	48	0			
q11 E-mail Address	48	0			
q12 Industry need to increase number of students	43	5	1.12	1.00	.324
q13 When you attended, were the class sizes too large	45	3	1.96	2.00	.208
q14 Last time you visited the HVAC building	48	0			
q15 Please indicate your initial salary range	48	0	2.60	2.00	1.854
q16 Please indicate your current salary range	44	4	7.27	8.00	1.730
q17 Most closely describes your daily activities	45	3	4.67	4.00	2.143
q17.a Other specified	48	0			
q18.a Basic Refrigeration	48	0	1.63	1.00	1.044
q18.b Electrical	48	0	1.48	1.00	.922
q18.c Commercial Refrigeration	47	1	2.19	1.00	1.409
q18.d Commercial Air Conditioning	46	2	1.54	1.00	.936
q18.e HVAC Design	47	1	1.64	1.00	.942
q18.f Oil	46	2	3.48	4.00	1.362
q18.g Gas	46	2	2.02	2.00	1.145
q18.h Controls	48	0	1.38	1.00	.640
q18.i Psychometrics	47	1	2.34	2.00	1.147
q18.j Math	47	1	1.94	2.00	.845
q18.k English	48	0	1.83	2.00	.953
q18.l Computer Skills	47	1	1.26	1.00	.488
q18.m Communication Skills	47	1	1.19	1.00	.449
q19.a Basic Refrigeration	47	1	1.45	1.00	.653

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q19.b Electrical	48	0	1.79	2.00	.898
q19.c Commercial Refrigeration	47	1	1.91	2.00	.880
q19.d Commercial Air Conditioning	47	1	1.77	2.00	.813
q19.e HVAC Design	48	0	1.81	2.00	.816
q19.f Oil	46	2	2.35	2.00	1.140
q19.g Gas	46	2	1.98	2.00	.906
q19.h Controls	48	0	2.06	2.00	.909
q19.i Psychometrics	46	2	2.00	2.00	1.011
q19.j Math	48	0	2.06	2.00	.783
q19.k English	48	0	2.17	2.00	.834
q19.l Computer Skills	43	5	2.86	3.00	1.457
q19.m Communication Skills	48	0	2.31	2.00	1.055
q20.a Need more technical content	45	3	1.24	1.00	.435
q20.b Need more social awareness courses	44	4	1.75	2.00	.438
q20.c Need more cultural enrichment courses	44	4	1.82	2.00	.390
q20.d Need more communication courses	45	3	1.29	1.00	.458
q20.e Need more writing intensive courses	44	4	1.50	1.50	.506
q21 Additional comments	48	0			

Frequency Table

q1 Name

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	2.1	2.1	2.1
	andrew miller	1	2.1	2.1	4.2
	Andy MacDonald	1	2.1	2.1	6.3
	Barry Cook	1	2.1	2.1	8.3
	Bob Middlebrook	1	2.1	2.1	10.4
	Brian Holton	1	2.1	2.1	12.5
	Calvin Johnson	1	2.1	2.1	14.6
	Chad Arnold	1	2.1	2.1	16.7
	Dave Hurst	1	2.1	2.1	18.8
	David Bonham	1	2.1	2.1	20.8
	David Shafer	1	2.1	2.1	22.9
	David Springs	1	2.1	2.1	25.0
	Donald P Oliver	1	2.1	2.1	27.1
	Donovan Denlinger	1	2.1	2.1	29.2
	Edmund Hauck	1	2.1	2.1	31.3
	Fred Hess	1	2.1	2.1	33.3
	Gary Schoenleber	1	2.1	2.1	35.4
	Irvin Derks	1	2.1	2.1	37.5
	James Jossman	1	2.1	2.1	39.6
	Jeff Salisbury	1	2.1	2.1	41.7
	Jeremy Halligan	1	2.1	2.1	43.8
	John D. Crawford	1	2.1	2.1	45.8
	John Franklin	1	2.1	2.1	47.9
	Joseph Theisen	1	2.1	2.1	50.0
	Ken Lorincz	1	2.1	2.1	52.1
	Kenneth Newma	1	2.1	2.1	54.2
	Larry Heemstra	1	2.1	2.1	56.3
	Lawrence J. Olszewski	1	2.1	2.1	58.3
	Mark Angellotti	1	2.1	2.1	60.4
	Michael Convery	1	2.1	2.1	62.5
	Michael Dragoo	1	2.1	2.1	64.6
	Patrick L. Whitton	1	2.1	2.1	66.7
	Paul Needham	1	2.1	2.1	68.8
	Paul Overbeek	1	2.1	2.1	70.8
	Randy Seaman	1	2.1	2.1	72.9
	Richie Piatkowski	1	2.1	2.1	75.0
	Robert John Tudball	1	2.1	2.1	77.1
	Rodney Cook	1	2.1	2.1	79.2
	Ryan Fiebig	1	2.1	2.1	81.3
	Stanley Hill	1	2.1	2.1	83.3
	Stephen m. Schoenberg	1	2.1	2.1	85.4

q1 Name

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Steven Coen	1	2.1	2.1	87.5
	Steven R. Charters	1	2.1	2.1	89.6
	Ted Heneka	1	2.1	2.1	91.7
	Terrence L. Rollins, MBA	1	2.1	2.1	93.8
	Thomas Gillig	1	2.1	2.1	95.8
	Thomas Vieyra	1	2.1	2.1	97.9
	Tim Dooling	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q2_1 Degree(s) earned at Ferris: HVACR AAS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	6	12.5	12.5	12.5
	Selected	42	87.5	87.5	100.0
	Total	48	100.0	100.0	

q2_2 Degree(s) earned at Ferris: HVACR BS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	36	75.0	75.0	75.0
	Selected	12	25.0	25.0	100.0
	Total	48	100.0	100.0	

q2_3 Degree(s) earned at Ferris: Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	41	85.4	85.4	85.4
	Selected	7	14.6	14.6	100.0
	Total	48	100.0	100.0	

q2.a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		39	81.3	81.3	81.3
	Automotive Service AAS	1	2.1	2.1	83.3
	Bachelors in Business Management	1	2.1	2.1	85.4
	BS Business Administration	1	2.1	2.1	87.5
	BS in business marketing Ferris State University	1	2.1	2.1	89.6
	Business Administration BS	1	2.1	2.1	91.7
	Completed program in '65 not sure what degree name.	1	2.1	2.1	93.8
	Construction Management BS	1	2.1	2.1	95.8
	I go back to the days of the energy management degree, 1989	1	2.1	2.1	97.9
	Refrigerating Heating and Air Conditioning (RHAC 1983)	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q3 Year earned HVACR AAS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		8	16.7	16.7	16.7
	1961	1	2.1	2.1	18.8
	1964	1	2.1	2.1	20.8
	1965	1	2.1	2.1	22.9
	1968	1	2.1	2.1	25.0
	1969	2	4.2	4.2	29.2
	1970	1	2.1	2.1	31.3
	1973	3	6.3	6.3	37.5
	1977	3	6.3	6.3	43.8
	1979	2	4.2	4.2	47.9
	1980	1	2.1	2.1	50.0
	1981	3	6.3	6.3	56.3
	1982	2	4.2	4.2	60.4
	1983	1	2.1	2.1	62.5
	1984	1	2.1	2.1	64.6
	1985	2	4.2	4.2	68.8
	1986	1	2.1	2.1	70.8
	1988	1	2.1	2.1	72.9
	1992	2	4.2	4.2	77.1
	1994	1	2.1	2.1	79.2
	1995	1	2.1	2.1	81.3
	1996	1	2.1	2.1	83.3
	1997	2	4.2	4.2	87.5
	1999	2	4.2	4.2	91.7
	2003	1	2.1	2.1	93.8
	2004	1	2.1	2.1	95.8
	2010	1	2.1	2.1	97.9
	2011	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q4 Year earned HVACR BS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		36	75.0	75.0	75.0
	1967	1	2.1	2.1	77.1
	1979	1	2.1	2.1	79.2
	1989	1	2.1	2.1	81.3
	1993	1	2.1	2.1	83.3
	1997	1	2.1	2.1	85.4
	1998	1	2.1	2.1	87.5
	1999	1	2.1	2.1	89.6
	2001	1	2.1	2.1	91.7
	2005	2	4.2	4.2	95.8
	2006	1	2.1	2.1	97.9
	2012	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q5 Home Address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	8.3	8.3	8.3
	10100 South Blvd Cleveland, Ohio 44108	1	2.1	2.1	10.4
	10746 Braden Rd Byron MI, 48418	1	2.1	2.1	12.5
	11007 Walker St Grand Blanc, MI 48439	1	2.1	2.1	14.6
	115 Schultz Road Sellersville, PA 18960	1	2.1	2.1	16.7
	11833 Bailey Dr. NE Lowell, Mi. 49331	1	2.1	2.1	18.8
	12512 whisper ridge. Freeland mi 48623	1	2.1	2.1	20.8
	1326 Oakleigh Rd NW Grand Rapids, MI 49504	1	2.1	2.1	22.9
	13430 Novotny Rd Charlevoix, MI 49720	1	2.1	2.1	25.0
	13519 County Road H Bryan, Ohio 43506	1	2.1	2.1	27.1
	14354 Kingwood Riverview, MI 48193	1	2.1	2.1	29.2
	1441 Millstone Ct Bethlehem, GA. 30620	1	2.1	2.1	31.3
	1550 S 13th St. Niles MI 49120	1	2.1	2.1	33.3
	1738 Locust Street Norristown, PA 19401	1	2.1	2.1	35.4
	177 Barrington Circle, Lake Orion, MI 48360	1	2.1	2.1	37.5
	1823 Scully Rd. Mt. Pleasant, MI 48858	1	2.1	2.1	39.6
	1833 S Cambridge St. Joseph, MI 49085	1	2.1	2.1	41.7
	18505 7 Mile Rd Reed City, Mi	1	2.1	2.1	43.8
	19413 Inkster Rd., Livonia, MI 48152	1	2.1	2.1	45.8
	1944 Lakeview Dr Zeeland, Mi 49464	1	2.1	2.1	47.9
	21590 22 mile rd, Paris, MI,49338	1	2.1	2.1	50.0
	2420 dawn Jackson MI 49203	1	2.1	2.1	52.1
	2572 Van Dyke Conklin, Mi 49403	1	2.1	2.1	54.2
	2678 Locksley Ct. Troy Mi. 48083	1	2.1	2.1	56.3
	2699 Thrush Dr Jenisoon, MI 49428	1	2.1	2.1	58.3

q5 Home Address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2802 Spielman Heights Dr West Adrian, MI 49221	1	2.1	2.1	60.4
	2914 Sharon Ave. SW Wyoming, MI 49519	1	2.1	2.1	62.5
	331 Ruff Dr Monroe, MI 48162	1	2.1	2.1	64.6
	3386 Breezewood Court Ortonville, Mi 48462	1	2.1	2.1	66.7
	3597 Scenic Drive North Muskegon Mi 49445	1	2.1	2.1	68.8
	3650 Hi-Dale Drive Lake Orion, MI 48360	1	2.1	2.1	70.8
	37868 Connaught Dr	1	2.1	2.1	72.9
	37962 Munger Livonia,Mi 48154	1	2.1	2.1	75.0
	4049 w maple rd wixom, mi 48393	1	2.1	2.1	77.1
	4103 Winter Lane Valparaiso Indiana 46385	1	2.1	2.1	79.2
	4198 Blood Road, Metamora, MI 48455	1	2.1	2.1	81.3
	4485 Pratt Lake Rd.	1	2.1	2.1	83.3
	4901 Bard Rd Whitehall, MI 49461	1	2.1	2.1	85.4
	5289 Reid Rd Swartz Creek, MI 48473	1	2.1	2.1	87.5
	5470 Brookdale Bloomfield Hills, MI 48304	1	2.1	2.1	89.6
	575 Valley ct Tipton, Mich. 49287	1	2.1	2.1	91.7
	6417 Pleasant River Drive Dimondale, MI 48821	1	2.1	2.1	93.8
	830 Country Club Drive Battle Creek Mich 49015	1	2.1	2.1	95.8
	870 W Wilkinson rd, Owosso, mi 48867	1	2.1	2.1	97.9
	Ryan Fiebig 2908 Woodglen St. NW Grand Rapids Michigan 49504	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q6 Home Phone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		9	18.8	18.8	18.8
	(517) 263-1362	1	2.1	2.1	20.8
	2153612654	1	2.1	2.1	22.9
	216-421-2096	1	2.1	2.1	25.0
	219-477-6512	1	2.1	2.1	27.1
	231-766-0039	1	2.1	2.1	29.2
	231-766-3121	1	2.1	2.1	31.3
	231-796-8863	1	2.1	2.1	33.3
	231-8321606	1	2.1	2.1	35.4
	248-207-1449	1	2.1	2.1	37.5
	248-393-2855	1	2.1	2.1	39.6
	248-627-6054	1	2.1	2.1	41.7
	248-646-6647	1	2.1	2.1	43.8
	248-669-1445	1	2.1	2.1	45.8
	248-689-7749	1	2.1	2.1	47.9
	248-875-1429	1	2.1	2.1	50.0
	269-208-8048	1	2.1	2.1	52.1
	269-683-5488	1	2.1	2.1	54.2
	269-963-3714	1	2.1	2.1	56.3
	419-636-4124	1	2.1	2.1	58.3
	517-592-3297	1	2.1	2.1	60.4
	517-784-8382	1	2.1	2.1	62.5
	517-881-7217	1	2.1	2.1	64.6
	610-279-6757	1	2.1	2.1	66.7
	616 899 5431	1	2.1	2.1	68.8
	616-669-7979	1	2.1	2.1	70.8
	616-723-3191	1	2.1	2.1	72.9
	616-748-9980	1	2.1	2.1	75.0
	616-862-3447	1	2.1	2.1	77.1
	616-893-7372	1	2.1	2.1	79.2
	616-897-5807	1	2.1	2.1	81.3
	734-464-3586	1	2.1	2.1	83.3
	734-735-0475	1	2.1	2.1	85.4
	734.479.6528	1	2.1	2.1	87.5
	770-868-2859	1	2.1	2.1	89.6
	810-266-4161	1	2.1	2.1	91.7
	810-407-1057	1	2.1	2.1	93.8
	989-205-5297	1	2.1	2.1	95.8
	989-725-9768	1	2.1	2.1	97.9
	9894264945	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q7 Work Phone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		18	37.5	37.5	37.5
	(734) 585-9442	1	2.1	2.1	39.6
	216-269-6725	1	2.1	2.1	41.7
	219-764-5200	1	2.1	2.1	43.8
	231-591-2352	1	2.1	2.1	45.8
	2316750665	1	2.1	2.1	47.9
	248-318-3390	1	2.1	2.1	50.0
	248-449-1241	1	2.1	2.1	52.1
	248-521-8207	1	2.1	2.1	54.2
	248-872-2604	1	2.1	2.1	56.3
	269_923_5248	1	2.1	2.1	58.3
	269-923-5127	1	2.1	2.1	60.4
	361-218-6509	1	2.1	2.1	62.5
	419-553-6307 [cell]	1	2.1	2.1	64.6
	586-883-2403	1	2.1	2.1	66.7
	6105675042	1	2.1	2.1	68.8
	616-458-1544	1	2.1	2.1	70.8
	616-532-8887	1	2.1	2.1	72.9
	616-796-0200	1	2.1	2.1	75.0
	616-866-7728	1	2.1	2.1	77.1
	6167233191	1	2.1	2.1	79.2
	734-241-4277	1	2.1	2.1	81.3
	734,676.4488	1	2.1	2.1	83.3
	770-285-3309	1	2.1	2.1	85.4
	810-743-6883	1	2.1	2.1	87.5
	989-773-7981	1	2.1	2.1	89.6
	9892336570	1	2.1	2.1	91.7
	9894262151	1	2.1	2.1	93.8
	NA Retired	1	2.1	2.1	95.8
	retired	1	2.1	2.1	97.9
	same	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q8 Company name

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	12.5	12.5	12.5
	Airtech Equipment, Inc.	1	2.1	2.1	14.6
	Alcoa Aluminum	1	2.1	2.1	16.7
	Alcoa Howmet	1	2.1	2.1	18.8
	All-Cleveland Refrigeration	1	2.1	2.1	20.8
	Bonham Heating and A/C	1	2.1	2.1	22.9
	Carrier Corporation	1	2.1	2.1	25.0
	Control Resource (Hurst Mechanical)	1	2.1	2.1	27.1
	Detroit Trane service agency	1	2.1	2.1	29.2
	Expert Heating and Cooling	1	2.1	2.1	31.3
	Ferris State Univ	1	2.1	2.1	33.3
	Ferris State Univrsity	1	2.1	2.1	35.4
	G.W. Berkheimer Co.,Inc.	1	2.1	2.1	37.5
	GMB Architecture + Engineering	1	2.1	2.1	39.6
	Goyette Mechanical Co., Inc.	1	2.1	2.1	41.7
	Greensleeves Energy Solutions LLC	1	2.1	2.1	43.8
	GRIPS Inc	1	2.1	2.1	45.8
	Hill Phoenix	1	2.1	2.1	47.9
	Honeywell international	1	2.1	2.1	50.0
	I retired from Johnson Controls in June 2011 after 15 years working on the at&t project in Lansing, MI. Work included packaged equipment, split systems, hot water boilers, chillers, cooling towers, and datacom cooling.	1	2.1	2.1	52.1
	Inovision Software Solutions	1	2.1	2.1	54.2
	Jackson National Life Insurance	1	2.1	2.1	56.3
	Janssen Referigeration	1	2.1	2.1	58.3
	Johnson Controls Inc	1	2.1	2.1	60.4
	Johnson Controls, Inc.	1	2.1	2.1	62.5
	Jones Lang LaSalle	1	2.1	2.1	64.6
	Kellogg Co	1	2.1	2.1	66.7
	Lammers heating	1	2.1	2.1	68.8
	Manitowoc	1	2.1	2.1	70.8

q8 Company name

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Monroe Plumbing & Heating	1	2.1	2.1	72.9
	Novi Community School District	1	2.1	2.1	75.0
	Process Engineering & Equipment Company	1	2.1	2.1	77.1
	Quality Air	1	2.1	2.1	79.2
	Retired	2	4.2	4.2	83.3
	Retired from Meijer after 35 yrs.	1	2.1	2.1	85.4
	RHC Global Energy Solutions	1	2.1	2.1	87.5
	Seaman's Mechanical	1	2.1	2.1	89.6
	Target Construction	1	2.1	2.1	91.7
	Tecumseh Products Company	1	2.1	2.1	93.8
	Trane	1	2.1	2.1	95.8
	Whirlpool Corp.	1	2.1	2.1	97.9
	Xerox Consultant Company, Inc.	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q9 Position Title

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		7	14.6	14.6	14.6
	Assistant Professor	1	2.1	2.1	16.7
	BAS Technician	1	2.1	2.1	18.8
	Battle Creek Plant Mainttenance Manager	1	2.1	2.1	20.8
	CEO	1	2.1	2.1	22.9
	CEO, President, Owner	1	2.1	2.1	25.0
	Commercial Unitary Equipment Manager, Central Region	1	2.1	2.1	27.1
	Controls Engineer	1	2.1	2.1	29.2
	Corporate Environmental, Health and Safety Manager	1	2.1	2.1	31.3
	Director of Facilities	1	2.1	2.1	33.3
	Director of Field Operations	1	2.1	2.1	35.4
	Director of Maintenance ans Operations	1	2.1	2.1	37.5
	Energy Solutions Development Engineering Manager – Michigan & Wisconsin	1	2.1	2.1	39.6
	Estimator	1	2.1	2.1	41.7
	Facilites Engineer	1	2.1	2.1	43.8
	facilities Coordinator	1	2.1	2.1	45.8
	Field Project Manager	1	2.1	2.1	47.9
	Group Manager, NA Product Marketing	1	2.1	2.1	50.0
	Inside Sales Engineer - National Accounts	1	2.1	2.1	52.1
	Maintenance Mgr	1	2.1	2.1	54.2
	Manager	1	2.1	2.1	56.3
	Mechanical Design Engineer	1	2.1	2.1	58.3
	Outside Sales Engineer	1	2.1	2.1	60.4
	Owner	1	2.1	2.1	62.5
	Owner/President	1	2.1	2.1	64.6
	President	2	4.2	4.2	68.8
	Retired from Mechanical Contracting in 2011	1	2.1	2.1	70.8
	Sales	1	2.1	2.1	72.9
	Sales Associate	1	2.1	2.1	75.0
	Sales Engineer	1	2.1	2.1	77.1
	Senior Lab Technician	1	2.1	2.1	79.2
	Service Engineer	1	2.1	2.1	81.3

q9 Position Title

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Service Manager, Safety Coordinator, Project Manager, Estimator	1	2.1	2.1	83.3
	Service Tech	1	2.1	2.1	85.4
	Serviceman	1	2.1	2.1	87.5
	Sole Owner	1	2.1	2.1	89.6
	Sr automation tech	1	2.1	2.1	91.7
	Sr. Software Engineer	1	2.1	2.1	93.8
	Tool Room Manager	1	2.1	2.1	95.8
	Vice President Inventory Management	1	2.1	2.1	97.9
	Vice President of Engineering	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q10 Company Address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		11	22.9	22.9	22.9
	10100 South Blvd Cleveland, Ohio 44108	1	2.1	2.1	25.0
	1136 Oak Valley Drive Ann Arbor, MI 48108	1	2.1	2.1	27.1
	1738 Locust Street Norristown, PA 19401	1	2.1	2.1	29.2
	201 W. Washington, Zeeland, MI 49464	1	2.1	2.1	31.3
	21811 Allen Rd. Woodhaven, MI	1	2.1	2.1	33.3
	235 P0rter Street Battle Creek Michigan 49015	1	2.1	2.1	35.4
	2441 W. M-61	1	2.1	2.1	37.5
	2510 Oak Industrial Dr. NE Grand Rapids, Mi. 49505	1	2.1	2.1	39.6
	2520 Lansing Ave Jackson,MI 49201	1	2.1	2.1	41.7
	26725 Bunert Warren, MI 48098	1	2.1	2.1	43.8
	2875 High Meadow Cir, Auburn Hills, MI, 48326	1	2.1	2.1	45.8
	2875 High Meadow Circle, Auburn Hills, MI 48326	1	2.1	2.1	47.9
	3395 Kraft SE	1	2.1	2.1	50.0
	3523 Lousma Dr SE Grand Rapids, MI 49548	1	2.1	2.1	52.1
	3620 Busch Dr Grandville, Mi 49418	1	2.1	2.1	54.2
	37001 Industrial Rd. Livonia, MI 48150	1	2.1	2.1	56.3
	3842 Gorey Ave. Flint, MI 48506	1	2.1	2.1	58.3
	3850 White Lake DR Whitehall, MI 49461	1	2.1	2.1	60.4
	4110 Butler Pike, Suite A104 Plymouth Meeting, PA 19446	1	2.1	2.1	62.5
	45495 w. 11 mile rd. Novi, MI. 48374	1	2.1	2.1	64.6
	506 Cooper St. Monroe, MI 48161	1	2.1	2.1	66.7
	5153 hampton place, saginaw mu	1	2.1	2.1	68.8
	5225 Auto Club Drive Dearborn, MI 48126	1	2.1	2.1	70.8
	571 Six Mile Rd NW Comstock Park, MI 49321	1	2.1	2.1	72.9

q10 Company Address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5800 Safety Drive Belmont, MI 49306	1	2.1	2.1	75.0
	6000 Southport Road Portage Indiana 46368	1	2.1	2.1	77.1
	605 S Warren Ave Big Rapids MI	1	2.1	2.1	79.2
	605 S.Warren	1	2.1	2.1	81.3
	709 Sigman Road Conyers, GA 30013	1	2.1	2.1	83.3
	85 E 8th St holland michigan 49423	1	2.1	2.1	85.4
	980 s. Isabella Rd. Mt. Pleasant, MI 48858	1	2.1	2.1	87.5
	Edgewater Technology Center 451 rebaissance Drive, MD 1300 St. Joseph MI 49085	1	2.1	2.1	89.6
	Inovision Software Solutions 50561 Chesterfield Rd, Chesterfield, MI 48051	1	2.1	2.1	91.7
	Jones Lang LaSalle 2000 M63 North MD6004 Benton Harbor, MI 49022	1	2.1	2.1	93.8
	One Corporate Way Lansing Mi 48915	1	2.1	2.1	95.8
	Pittsburgh, Pa	1	2.1	2.1	97.9
	po box J Cedar Springs Mi 49319	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q11 E-mail Address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		7	14.6	14.6	14.6
	482fish@charter.net	1	2.1	2.1	16.7
	bob. middlebrook@qualityairinc .com	1	2.1	2.1	18.8
	bonhamdave@gmail.com	1	2.1	2.1	20.8
	caljohnson4@gmail.com	1	2.1	2.1	22.9
	Carl.kravat@honeywell. com	1	2.1	2.1	25.0
	carnold@hurstind.com	1	2.1	2.1	27.1
	david.shafer@alcoa.com	1	2.1	2.1	29.2
	davidbsprings@gmail.com	1	2.1	2.1	31.3
	donaldpoliver@msn.com	1	2.1	2.1	33.3
	donovan. denlinger@carrier.utc.com	1	2.1	2.1	35.4
	echauck@gmail.com	1	2.1	2.1	37.5
	Gary_f_ schoenleber@whirlpool.co m	1	2.1	2.1	39.6
	Gomey81@hotmail.com	1	2.1	2.1	41.7
	holt8@ferris.edu	1	2.1	2.1	43.8
	irvderks@williams-net. com	1	2.1	2.1	45.8
	Isealtruck@aol.com	1	2.1	2.1	47.9
	j.jossman@comcast.net	1	2.1	2.1	50.0
	jeffery. salisbury@tecumseh.com	1	2.1	2.1	52.1
	jhalligan@goyettemechani cal.com	1	2.1	2.1	54.2
	joet@monroeplumbing. com	1	2.1	2.1	56.3
	john_ crawford8225@yahoo.co m	1	2.1	2.1	58.3
	knewman@targetconst. com	1	2.1	2.1	60.4
	lorinczk@ferris.edu	1	2.1	2.1	62.5
	mangellotti@expertheatco ol.com	1	2.1	2.1	64.6
	mdragoo@novi.k12.mi.us	1	2.1	2.1	66.7
	michael.john. convery@gmail.com	1	2.1	2.1	68.8
	NA Retired	1	2.1	2.1	70.8
	paulmc@gripsmc.com	1	2.1	2.1	72.9

q11 E-mail Address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	pneedham46@yahoo.com	1	2.1	2.1	75.0
	Randy@Seamans Mechanical.com	1	2.1	2.1	77.1
	rcook@pecopage.com	1	2.1	2.1	79.2
	Richie. Piatkowski@manitowoc. com	1	2.1	2.1	81.3
	robert.j.tudball@jci.com	1	2.1	2.1	83.3
	rollinsterrence@netscape. net	1	2.1	2.1	85.4
	Ryan7418@aim.com	1	2.1	2.1	87.5
	steve. charters@hillphoenix.com	1	2.1	2.1	89.6
	tedheneka@gwberkheime r.com	1	2.1	2.1	91.7
	tgillig@trane,com	1	2.1	2.1	93.8
	timothy.dooling@jackson. com	1	2.1	2.1	95.8
	tommy1946z@yahoo.com	1	2.1	2.1	97.9
	www.fredrick_w_ hess@whirlpool.com	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q12 Industry need to increase number of students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	38	79.2	88.4	88.4
	No	5	10.4	11.6	100.0
	Total	43	89.6	100.0	
Missing	System	5	10.4		
Total		48	100.0		

q13 When you attended, were the class sizes too large

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	2	4.2	4.4	4.4
	No	43	89.6	95.6	100.0
	Total	45	93.8	100.0	
Missing	System	3	6.3		
Total		48	100.0		

q14 Last time you visited the HVAC building

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	8.3	8.3	8.3
	12 years	1	2.1	2.1	10.4
	1967	1	2.1	2.1	12.5
	1973	1	2.1	2.1	14.6
	1976	1	2.1	2.1	16.7
	1977	1	2.1	2.1	18.8
	1979	1	2.1	2.1	20.8
	1980's	1	2.1	2.1	22.9
	1985	1	2.1	2.1	25.0
	1988	1	2.1	2.1	27.1
	1990	1	2.1	2.1	29.2
	1992	1	2.1	2.1	31.3
	1995	3	6.3	6.3	37.5
	1998	1	2.1	2.1	39.6
	1999	1	2.1	2.1	41.7
	20 years	1	2.1	2.1	43.8
	2000	1	2.1	2.1	45.8
	2006	1	2.1	2.1	47.9
	2008	1	2.1	2.1	50.0
	2009	2	4.2	4.2	54.2
	2010	2	4.2	4.2	58.3
	2011	2	4.2	4.2	62.5
	3 or 4 years ago at homecoming	1	2.1	2.1	64.6
	30yrs	1	2.1	2.1	66.7
	4 to 5 years ago	1	2.1	2.1	68.8
	5/1/2012	1	2.1	2.1	70.8
	April 2011	1	2.1	2.1	72.9
	April 2012	1	2.1	2.1	75.0
	April, 2012	1	2.1	2.1	77.1
	ASHRAE Meeting April 08 or 09	1	2.1	2.1	79.2
	Can't recall but it was when opened the new building.	1	2.1	2.1	81.3
	graduation	1	2.1	2.1	83.3
	I don't remember. Several years ago.	1	2.1	2.1	85.4
	Late 90's	1	2.1	2.1	87.5
	March 2012	1	2.1	2.1	89.6
	med nineties	1	2.1	2.1	91.7
	N/A	1	2.1	2.1	93.8
	Still in school	1	2.1	2.1	95.8

q14 Last time you visited the HVAC building

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Summer 2010	1	2.1	2.1	97.9
	ten minutes ago	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q15 Please indicate your initial salary range

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below $20,000	19	39.6	39.6	39.6
	$20,000 - $25,000	13	27.1	27.1	66.7
	$25,001 - $30,000	2	4.2	4.2	70.8
	$30,001 - $35,000	2	4.2	4.2	75.0
	$35,001 - $40,000	6	12.5	12.5	87.5
	$40,001 - $45,000	6	12.5	12.5	100.0
	Total	48	100.0	100.0	

q16 Please indicate your current salary range

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below $25,000	2	4.2	4.5	4.5
	$35,001 - $40,000	2	4.2	4.5	9.1
	$40,001 - $45,000	2	4.2	4.5	13.6
	$50,001 - $60,000	4	8.3	9.1	22.7
	More than $60,000	34	70.8	77.3	100.0
	Total	44	91.7	100.0	
Missing	System	4	8.3		
Total		48	100.0		

q17 Most closely describes your daily activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Estimating/Design	2	4.2	4.4	4.4
	Marketing/Sales	5	10.4	11.1	15.6
	Field/Shop Service	6	12.5	13.3	28.9
	Company Management/Ownership	15	31.3	33.3	62.2
	Lab Technician	2	4.2	4.4	66.7
	Application Engineer	3	6.3	6.7	73.3
	Controls	4	8.3	8.9	82.2
	Other	8	16.7	17.8	100.0
	Total	45	93.8	100.0	
Missing	System	3	6.3		
Total		48	100.0		

q17.a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		35	72.9	72.9	72.9
	Chiller plant operating engineer, minor maintenance technician, troubleshooter, assistant manager.	1	2.1	2.1	75.0
	currently retired, see comments below.	1	2.1	2.1	77.1
	Director of Facilities for a large financial planning company based in Michigan	1	2.1	2.1	79.2
	Field Project Manager for a Equipment Manufacture that supplies to Major Rest. Chain Accounts	1	2.1	2.1	81.3
	HVAC Design Layout	1	2.1	2.1	83.3
	HVAC Technician	1	2.1	2.1	85.4
	Leading team of engineers, leading development of projects	1	2.1	2.1	87.5
	Manager: Food Service, Grounds, Janitorial and Warehouse	1	2.1	2.1	89.6
	Prior to retiring I was Vice President of Engineering for Bard Manufacturing Co. I directed a team of 23 engineers, lab technicians and draftsman in development of new products for heating and air conditioning.	1	2.1	2.1	91.7
	retired	1	2.1	2.1	93.8
	Retired, 2003	1	2.1	2.1	95.8
	Software engineering	1	2.1	2.1	97.9
	Teaching	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q18.a Basic Refrigeration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	33	68.8	68.8	68.8
	Important	4	8.3	8.3	77.1
	Relevant	8	16.7	16.7	93.8
	Not Very Important	2	4.2	4.2	97.9
	Unimportant	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q18.b Electrical

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	34	70.8	70.8	70.8
	Important	9	18.8	18.8	89.6
	Relevant	2	4.2	4.2	93.8
	Not Very Important	2	4.2	4.2	97.9
	Unimportant	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q18.c Commercial Refrigeration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	24	50.0	51.1	51.1
	Important	4	8.3	8.5	59.6
	Relevant	9	18.8	19.1	78.7
	Not Very Important	6	12.5	12.8	91.5
	Unimportant	4	8.3	8.5	100.0
	Total	47	97.9	100.0	
Missing	System	1	2.1		
Total		48	100.0		

q18.d Commercial Air Conditioning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	31	64.6	67.4	67.4
	Important	8	16.7	17.4	84.8
	Relevant	5	10.4	10.9	95.7
	Not Very Important	1	2.1	2.2	97.8
	Unimportant	1	2.1	2.2	100.0
	Total	46	95.8	100.0	
Missing	System	2	4.2		
Total		48	100.0		

q18.e HVAC Design

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	28	58.3	59.6	59.6
	Important	11	22.9	23.4	83.0
	Relevant	6	12.5	12.8	95.7
	Not Very Important	1	2.1	2.1	97.9
	Unimportant	1	2.1	2.1	100.0
	Total	47	97.9	100.0	
Missing	System	1	2.1		
Total		48	100.0		

q18.f Oil

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	6	12.5	13.0	13.0
	Important	5	10.4	10.9	23.9
	Relevant	9	18.8	19.6	43.5
	Not Very Important	13	27.1	28.3	71.7
	Unimportant	13	27.1	28.3	100.0
	Total	46	95.8	100.0	
Missing	System	2	4.2		
Total		48	100.0		

q18.g Gas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	21	43.8	45.7	45.7
	Important	11	22.9	23.9	69.6
	Relevant	6	12.5	13.0	82.6
	Not Very Important	8	16.7	17.4	100.0
	Total	46	95.8	100.0	
Missing	System	2	4.2		
Total		48	100.0		

q18.h Controls

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	34	70.8	70.8	70.8
	Important	10	20.8	20.8	91.7
	Relevant	4	8.3	8.3	100.0
	Total	48	100.0	100.0	

q18.i Psychometrics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	13	27.1	27.7	27.7
	Important	15	31.3	31.9	59.6
	Relevant	11	22.9	23.4	83.0
	Not Very Important	6	12.5	12.8	95.7
	Unimportant	2	4.2	4.3	100.0
	Total	47	97.9	100.0	
Missing	System	1	2.1		
Total		48	100.0		

q18.j Math

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	18	37.5	38.3	38.3
	Important	14	29.2	29.8	68.1
	Relevant	15	31.3	31.9	100.0
	Total	47	97.9	100.0	
Missing	System	1	2.1		
Total		48	100.0		

q18.k English

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	23	47.9	47.9	47.9
	Important	13	27.1	27.1	75.0
	Relevant	9	18.8	18.8	93.8
	Not Very Important	3	6.3	6.3	100.0
	Total	48	100.0	100.0	

q18.l Computer Skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	36	75.0	76.6	76.6
	Important	10	20.8	21.3	97.9
	Relevant	1	2.1	2.1	100.0
	Total	47	97.9	100.0	
Missing	System	1	2.1		
Total		48	100.0		

q18.m Communication Skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	39	81.3	83.0	83.0
	Important	7	14.6	14.9	97.9
	Relevant	1	2.1	2.1	100.0
	Total	47	97.9	100.0	
Missing	System	1	2.1		
Total		48	100.0		

q19.a Basic Refrigeration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	30	62.5	63.8	63.8
	Important	13	27.1	27.7	91.5
	Relevant	4	8.3	8.5	100.0
	Total	47	97.9	100.0	
Missing	System	1	2.1		
Total		48	100.0		

q19.b Electrical

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	22	45.8	45.8	45.8
	Important	17	35.4	35.4	81.3
	Relevant	6	12.5	12.5	93.8
	Not Very Important	3	6.3	6.3	100.0
	Total	48	100.0	100.0	

q19.c Commercial Refrigeration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	18	37.5	38.3	38.3
	Important	17	35.4	36.2	74.5
	Relevant	10	20.8	21.3	95.7
	Not Very Important	2	4.2	4.3	100.0
	Total	47	97.9	100.0	
Missing	System	1	2.1		
Total		48	100.0		

q19.d Commercial Air Conditioning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	21	43.8	44.7	44.7
	Important	17	35.4	36.2	80.9
	Relevant	8	16.7	17.0	97.9
	Not Very Important	1	2.1	2.1	100.0
	Total	47	97.9	100.0	
Missing	System	1	2.1		
Total		48	100.0		

q19.e HVAC Design

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	20	41.7	41.7	41.7
	Important	18	37.5	37.5	79.2
	Relevant	9	18.8	18.8	97.9
	Not Very Important	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q19.f Oil

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	14	29.2	30.4	30.4
	Important	11	22.9	23.9	54.3
	Relevant	13	27.1	28.3	82.6
	Not Very Important	7	14.6	15.2	97.8
	Unimportant	1	2.1	2.2	100.0
	Total	46	95.8	100.0	
Missing	System	2	4.2		
Total		48	100.0		

q19.g Gas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	16	33.3	34.8	34.8
	Important	18	37.5	39.1	73.9
	Relevant	9	18.8	19.6	93.5
	Not Very Important	3	6.3	6.5	100.0
	Total	46	95.8	100.0	
Missing	System	2	4.2		
Total		48	100.0		

q19.h Controls

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	15	31.3	31.3	31.3
	Important	18	37.5	37.5	68.8
	Relevant	12	25.0	25.0	93.8
	Not Very Important	3	6.3	6.3	100.0
	Total	48	100.0	100.0	

q19.i Psychometrics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	18	37.5	39.1	39.1
	Important	14	29.2	30.4	69.6
	Relevant	11	22.9	23.9	93.5
	Not Very Important	2	4.2	4.3	97.8
	Unimportant	1	2.1	2.2	100.0
	Total	46	95.8	100.0	
Missing	System	2	4.2		
Total		48	100.0		

q19.j Math

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	13	27.1	27.1	27.1
	Important	19	39.6	39.6	66.7
	Relevant	16	33.3	33.3	100.0
	Total	48	100.0	100.0	

q19.k English

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	11	22.9	22.9	22.9
	Important	20	41.7	41.7	64.6
	Relevant	15	31.3	31.3	95.8
	Not Very Important	2	4.2	4.2	100.0
	Total	48	100.0	100.0	

q19.l Computer Skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	9	18.8	20.9	20.9
	Important	12	25.0	27.9	48.8
	Relevant	7	14.6	16.3	65.1
	Not Very Important	6	12.5	14.0	79.1
	Unimportant	9	18.8	20.9	100.0
	Total	43	89.6	100.0	
Missing	System	5	10.4		
Total		48	100.0		

q19.m Communication Skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	12	25.0	25.0	25.0
	Important	17	35.4	35.4	60.4
	Relevant	12	25.0	25.0	85.4
	Not Very Important	6	12.5	12.5	97.9
	Unimportant	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

q20.a Need more technical content

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	34	70.8	75.6	75.6
	No	11	22.9	24.4	100.0
	Total	45	93.8	100.0	
Missing	System	3	6.3		
Total		48	100.0		

q20.b Need more social awareness courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	11	22.9	25.0	25.0
	No	33	68.8	75.0	100.0
	Total	44	91.7	100.0	
Missing	System	4	8.3		
Total		48	100.0		

q20.c Need more cultural enrichment courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	16.7	18.2	18.2
	No	36	75.0	81.8	100.0
	Total	44	91.7	100.0	
Missing	System	4	8.3		
Total		48	100.0		

q20.d Need more communication courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	32	66.7	71.1	71.1
	No	13	27.1	28.9	100.0
	Total	45	93.8	100.0	
Missing	System	3	6.3		
Total		48	100.0		

q20.e Need more writing intensive courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	22	45.8	50.0	50.0
	No	22	45.8	50.0	100.0
	Total	44	91.7	100.0	
Missing	System	4	8.3		
Total		48	100.0		

q21 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		23	47.9	47.9	47.9
	Additional Math courses for the engineering tech BS would be recommended.	1	2.1	2.1	50.0
	Become an accredited program to become a PE	1	2.1	2.1	52.1
	Before going to Ferris I had attended a community college for 1.5 years. I filled in with business classes that had the communications courses, business law, economics, etc. These courses did help me when I started my business. Maybe an entrepreneur with a 4 yr. degree would be helpful.	1	2.1	2.1	54.2
	Concentrate on the basics and people skills. The real learning starts after graduation.	1	2.1	2.1	56.3
	Continued education with a Mechanical Engineering Degree. 12 years of Engineering, 12 years as Plant Manager, 12 years as EHS Manager	1	2.1	2.1	58.3
	DDC Controls very important to understand and be able to access and service. Industrial level chiller training is in very high demand.	1	2.1	2.1	60.4
	I graduated from the HVAC program in 1981 computer skills were non existent at that time. My technical background coupled with my business degree has helped my growth more than any other degree could have for my profession.	1	2.1	2.1	62.5
	I have not reviewed the program in a very long time; however, I can say this: The Technology is changing all the time. Everyone, no-matter what walk they take needs to be socially and culturally aware of the people they are dealing with. Communication is probably the MOST important of skills and a person has to be FLEXIBLE in todays work environment. All people need to have a solid grasp of the English language, as well as the correct punctuation of sentences and spelling of words. The people enrolled in this curriculum would not excell in additional writing assignments and would probably resent them.	1	2.1	2.1	64.6
	I know people who want to enroll at FSU and the admissions procedure quickly frustates and discourages them from doing so. FSU/HVAC program is losing students because of the process.The program co-ordinator position is a joke. The person is spread to thin between teaching and co-ordinating.	1	2.1	2.1	66.7

q21 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	If possible, the AAS graduates should be highly encouraged to work one semester in a service environment,riding with a technician and hopefully getting an opportunity to put there skills to use. A similar scenario for 4 years grads with a summmer of internship with a engineer, distributor, manufactures rep, manufacturer if possible, etc. The skills learned in these internships would enhance a resume and be directly transferable to the field as it is in any other degree. If possible, arrange for credits to be received. Our industry is in dire need of qualified service technicians. Unfortunately, we are all looking for a tech with a few years direct field experience, especially on the service side. Young men coming out of school represent a good long term value but can't fill our immediate need. Becuase you have the finest facility in the industry, it might make sense to create a "boot camp" program for current residential based technicians to attend a 3-4 two day weekend b ootcamp to gain knowledge and experience on rooftops, and light commercial techs to gain some experience on some heavier gear. Also, a communication class where role playing is the focus since so many existing techs have not had any formal advanced education. This could be a money maker and a real asset to the industry. There are several entities trying to make progress on this but none of the are positioned as well as Ferris State to actually make it happen on a higher level.	1	2.1	2.1	68.8
	Math requirements for a technician are far below the math required for degree completion. There is all most no algebra required for technicians. Social awareness and cultural enrichment courses have a low value for technicians and add unnecessary cost to the degree.	1	2.1	2.1	70.8

q21 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	My preparation at Ferris was key to my career. I am now retired but enjoyed a great career and at a level that I never dreamed I could achieve. I have two patents and three more in process at the Patent and Trade Mark Office. I directed all new product design and development efforts. In addition, I served my company in the arena of Government Affairs and worked with our trade association [AHRI] serving on several committees and was the fou nder of a new product section within AHRI pushing it through ASHRAE, AHRI and the Department of Energy. It lead to President Bush signing it into law on December 7, 2007. Thank You.........to FSU.	1	2.1	2.1	72.9
	Need to educate students on other career opportunities in the HVACR fields other then technical in nature. There is and will continue to be a shortage of knowlegeable poeple in the industry and are needed for the wholesale distrubition field, Manufactures Rep Agency, etc.	1	2.1	2.1	75.0
	Please note that I earned my associate degree in 1974. Back in the days of Freon Fred Lawrence, Dick Shaw and Commander Cushway. ● I am unable to complete section 20 because I am not in touch with the current curriculum. ● Based on my career experience, I believe interpersonal skills should be emphasized. ● The relationship between condenser leaving water temperature and head pressure and its role in the control of towers and the setting of water regulating valves should be covered. ● I believe spreadsheet skills are absolutely essential. fundamentals of datacom cooling systems might be helpful.	1	2.1	2.1	77.1
	Please note that I graduated a very long time ago. I think it was very beneficial to my career that I did stay on for the BS degree.	1	2.1	2.1	79.2
	Since Ferris has offered the 4 year degree, there seems to be a lack of qualified "service techs". I believe alot of the grads don't want to get their hands dirty and learn the field trade. My track was a few years as a service tech, then I went into sales. Gave me a great base to work from.	1	2.1	2.1	81.3

q21 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Social / cultural yes perhaps if they are specific and focused on the political impacts to the industry or projects that students are working on for their future employer (perhaps tied to a current program). More in-depth financial analysis of projects - program covers pricing and savings - get more into blending these - cash flow analysis, funding, financing, take the business classes and apply them to the HVAC/R classes.	1	2.1	2.1	83.3
	The ability to communicate is essential but also to have a highly trained technical person is mandatory. Computer skills should also be emphasized.	1	2.1	2.1	85.4
	The education I received has kept food on my plate for the last forty years. If you need to speak to me personaly I am available.	1	2.1	2.1	87.5
	there are many other fields that can come out of your HVACR programs like sales, sheet metal and commercial heating	1	2.1	2.1	89.6
	There needs to be a stronger focus on the technical/troubleshooting aspect of our industry. This needs to be kept in mind all the way through the last two years of the four year degree. Not everyone wants to be a service technician but if you understand how it works it will make you much better and more valuable when you are controlling or designing the systems. If you can/want to get a few years of service work in it will make you that much better at controls , design or sales. So the people that don't want to do service need to get as much of the "field experiance" they can from Ferris.	1	2.1	2.1	91.7
	This program is the best thing in our industry even today! Keep the program going! I suggest that fsu look into fire system controls, camera systems and card access education since those industries run along with hvac for all large controls companies such as honeywell, johnson controls and so on!	1	2.1	2.1	93.8
	Update computers in labs, have a lab for students to work on homework that are not in class at the time.	1	2.1	2.1	95.8
	When attending Ferris my advisor signed me up for Techncial Writing Courses, this was not required but was used as credit towards required English Credits, this should be a manadatory class and is why I feel I did not need additional classes.	1	2.1	2.1	97.9

q21 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	When I attended in 1967-69, most atten was directed towards the tech areas and computers were just coming into the picture	1	2.1	2.1	100.0
	Total	48	100.0	100.0	

HVACR APR...BS Alumni

Frequencies

Prepared by: Institutional Research & Testing, 05/12

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q1 Name	25	0			
q2_1 Degree(s) earned at Ferris: HVACR AAS	25	0	.20	.00	.408
q2_2 Degree(s) earned at Ferris: HVACR BS	25	0	1.00	1.00	.000
q2_3 Degree(s) earned at Ferris: Other	25	0	.20	.00	.408
q2.a Other specified	25	0			
q3 Year earned HVACR AAS	25	0			
q4 Year earned HVACR BS	25	0			
q5 Home Address	25	0			
q6 Home Phone	25	0			
q7 Work Phone	25	0			
q8 Company name	25	0			
q9 Position Title	25	0			
q10 Company Address	25	0			
q11 E-mail Address	25	0			
q12 Industry need to increase number of students	22	3	1.00	1.00	.000
q13 Number of faculty per students be increased	21	4	1.33	1.00	.483
q14 Last time you visited the HVAC building	25	0			
q15 Please indicate your initial salary range	25	0	6.32	6.00	1.600
q16 Please indicate your current salary range	25	0	7.08	8.00	1.605
q17 Most closely describes your daily activities	24	1	5.92	6.00	2.145
q17.a Other specified	25	0			
q18.a HVAC design courses are important to your job	25	0	1.32	1.00	.476
q18.b Well prepared in the area of HVACR Design	24	1	1.46	1.00	.721
q18.c Use of CAD is important to your job	23	2	2.52	2.00	1.410
q18.d Well prepared in the area of CAD	25	0	2.76	3.00	1.332
q18.e Ability to do a load calculation is important to your job	25	0	2.24	2.00	1.128
q18.f Well prepared in the area of load calculations	25	0	1.80	2.00	.866
q18.g Equipment selection is an important part of your job	25	0	2.16	2.00	1.143
q18.h Well prepared in the area of equipment selection	25	0	1.68	2.00	.748
q18.i Control theory is an important part of you job	25	0	1.36	1.00	.700

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q18.j Well prepared in the area of control theory	25	0	1.56	2.00	.583
q18.k Control application is an important part of your job	25	0	1.48	1.00	.770
q18.l Well prepared in the area of control application	25	0	1.72	2.00	.843
q18.m Ability to read a blue print is an important part of your job	25	0	1.36	1.00	.907
q18.n Well prepared in the area of blue print reading	25	0	2.08	2.00	1.115
q18.o Ability to understand job specs is an important part of your job	25	0	1.48	1.00	.918
q18.p Well prepared to deal with job specifications	25	0	2.44	2.00	1.474
q18.q Math is an important part of your job	25	0	1.36	1.00	.569
q18.r Well prepared in the area of math	25	0	2.00	2.00	.913
q18.s Written communication skills is an important part of your job	25	0	1.20	1.00	.408
q18.t Well prepared in the area of written communications	25	0	1.84	2.00	.943
q18.u Verbal communication skills is an important part of your job	25	0	1.16	1.00	.374
q18.v Well prepared in the area of verbal communication	25	0	1.96	2.00	.841
q18.w Ability to troubleshoot is an important part of your job	25	0	1.32	1.00	.748
q18.x Well prepared in the area of troubleshooting	25	0	1.68	1.00	.988
q18.y Energy audits are an important part of your job	25	0	2.16	2.00	.943
q18.z Well prepared to do an energy audit	25	0	1.92	2.00	.759
q18.aa Ability to commission an HVAC system is an important part of your job	25	0	1.76	1.00	1.091
q18.ab Well prepared to commission HVAC equipment	25	0	2.12	2.00	1.092
q18.ac Overall, well prepared for the job that you are doing	25	0	1.64	2.00	.569
q18.ad The advising was adequate in the HVAC program	25	0	1.80	2.00	.913
q18.ae The placement services were adequate at Ferris	25	0	2.48	3.00	1.159
q18.af The mix of technical/social & cultural courses were adequate	25	0	2.04	2.00	.735
q18.ag You had no problem finding a job after graduation	24	1	1.38	1.00	.576
q18.ah You were able to be productive in your job right out of school	25	0	1.48	1.00	.510

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q18.ai There is a high demand for the HVACR-4 year graduate	25	0	1.68	1.00	1.108
q19 Additional comments	25	0			

Frequency Table

q1 Name

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Adam Wilson	1	4.0	4.0	4.0
	Andrew De-Weleyi	1	4.0	4.0	8.0
	Andrew Doe	1	4.0	4.0	12.0
	Andy Nurenberg	1	4.0	4.0	16.0
	Art Guzowski	1	4.0	4.0	20.0
	Blaine Banks	1	4.0	4.0	24.0
	Charles Day	1	4.0	4.0	28.0
	Chris Korn	1	4.0	4.0	32.0
	Daniel Drys	1	4.0	4.0	36.0
	David Sweet	1	4.0	4.0	40.0
	Dewayne Collins	1	4.0	4.0	44.0
	Jason Eaton	1	4.0	4.0	48.0
	Joshua Christoff	1	4.0	4.0	52.0
	Juan Allen	1	4.0	4.0	56.0
	Kim Pattee	1	4.0	4.0	60.0
	Matt Caruthers	1	4.0	4.0	64.0
	Michael Stark Gilmour	1	4.0	4.0	68.0
	Mike Feutz	1	4.0	4.0	72.0
	Mike Maynard	1	4.0	4.0	76.0
	Myron Ramage	1	4.0	4.0	80.0
	Neal Betts	1	4.0	4.0	84.0
	Nicholas Roush	1	4.0	4.0	88.0
	Nicholas Ruehmeier	1	4.0	4.0	92.0
	Philip Moody	1	4.0	4.0	96.0
	Rick Bennett	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q2_1 Degree(s) earned at Ferris: HVACR AAS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	20	80.0	80.0	80.0
	Selected	5	20.0	20.0	100.0
	Total	25	100.0	100.0	

q2_2 Degree(s) earned at Ferris: HVACR BS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	25	100.0	100.0	100.0

q2_3 Degree(s) earned at Ferris: Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	20	80.0	80.0	80.0
	Selected	5	20.0	20.0	100.0
	Total	25	100.0	100.0	

q2.a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		20	80.0	80.0	80.0
	AAS Electrical Power Technology	1	4.0	4.0	84.0
	BS in HVACR (1994) and MBA (2004)	1	4.0	4.0	88.0
	Certificate Marketing/Sales	1	4.0	4.0	92.0
	Minor CIS	1	4.0	4.0	96.0
	MSCTE	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q3 Year earned HVACR AAS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		20	80.0	80.0	80.0
	1996	1	4.0	4.0	84.0
	2000	1	4.0	4.0	88.0
	2002	1	4.0	4.0	92.0
	2005	1	4.0	4.0	96.0
	2007	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q4 Year earned HVACR BS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1989	1	4.0	4.0	4.0
	1989?	1	4.0	4.0	8.0
	1991	1	4.0	4.0	12.0
	1992	1	4.0	4.0	16.0
	1994	1	4.0	4.0	20.0
	1995	1	4.0	4.0	24.0
	1997	2	8.0	8.0	32.0
	1998	1	4.0	4.0	36.0
	1999	1	4.0	4.0	40.0
	2000	2	8.0	8.0	48.0
	2001	3	12.0	12.0	60.0
	2003	1	4.0	4.0	64.0
	2004	1	4.0	4.0	68.0
	2005	1	4.0	4.0	72.0
	2006	2	8.0	8.0	80.0
	2007	1	4.0	4.0	84.0
	2008	1	4.0	4.0	88.0
	2010	1	4.0	4.0	92.0
	2011	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

q5 Home Address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	11325 Cameron Ave. Allendale, Michigan 49401	1	4.0	4.0	4.0
	12197 Biddle Drive Fishers IN 46037	1	4.0	4.0	8.0
	12300 Churchill Ave.	1	4.0	4.0	12.0
	13338 Terri Lyn Lane Apt 4 Holland, MI 49424	1	4.0	4.0	16.0
	14905 W. Hanses Rd Westphalia, MI 48894	1	4.0	4.0	20.0
	16725 Heim Road Chelsea, MI	1	4.0	4.0	24.0
	1745 Ranch Dr., NW Grand Rapids, MI 49504	1	4.0	4.0	28.0
	1748 S Pine Ave White Cloud, MI 49349	1	4.0	4.0	32.0
	177 West Wheelock Parkway, Saint Paul, MN, 55117	1	4.0	4.0	36.0
	2313 N. 150 E. Rushville, IN 46173	1	4.0	4.0	40.0
	23850 SE 111th St. Issaquah, WA 98027	1	4.0	4.0	44.0
	25175 Justice Dr. Chantilly VA 20152	1	4.0	4.0	48.0
	2638 Fernleaf Drive Green Cove Springs, FL 32043	1	4.0	4.0	52.0
	2665 Ashville NE GR MI 49525	1	4.0	4.0	56.0
	3191 Shear NE Grand Rapids MI 49525	1	4.0	4.0	60.0
	448 Mower St. Worcester MA, 01602	1	4.0	4.0	64.0
	5115 N 18th Tacoma, WA 98406	1	4.0	4.0	68.0
	5228 Ridgebrook Dr. Portage, MI 49002	1	4.0	4.0	72.0
	5717 155th LN NW Ramsey, MN 55303	1	4.0	4.0	76.0
	5802 King Arthur Glenn, Dale Maryland 20769	1	4.0	4.0	80.0
	59 Kingsmeadow Ln. Blacklick, OH 43004	1	4.0	4.0	84.0
	7139 Pheasant Ridge Dr. Indianapolis, In 46237	1	4.0	4.0	88.0
	7414 Orlee St. SE Caledonia, MI	1	4.0	4.0	92.0
	Dallas, tx	1	4.0	4.0	96.0
	Milwaukee, Wisconsin	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q6 Home Phone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	20.0	20.0	20.0
	(253) 948-2376	1	4.0	4.0	24.0
	231-689-3974	1	4.0	4.0	28.0
	269-349-9836	1	4.0	4.0	32.0
	269-830-3896	1	4.0	4.0	36.0
	301-464-7614	1	4.0	4.0	40.0
	317-845-5287	1	4.0	4.0	44.0
	4252819362	1	4.0	4.0	48.0
	5075148198	1	4.0	4.0	52.0
	508-799-3179	1	4.0	4.0	56.0
	612-889-4920	1	4.0	4.0	60.0
	614-477-6829	1	4.0	4.0	64.0
	6145635291	1	4.0	4.0	68.0
	616 447-0148	1	4.0	4.0	72.0
	616-453-2119	1	4.0	4.0	76.0
	616-648-5763	1	4.0	4.0	80.0
	630-306-5998	1	4.0	4.0	84.0
	703-327-5357	1	4.0	4.0	88.0
	734 358-8907	1	4.0	4.0	92.0
	765-938-7293	1	4.0	4.0	96.0
	810-869-4514	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q7 Work Phone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		8	32.0	32.0	32.0
	(253) 572-9484	1	4.0	4.0	36.0
	202-885-2336	1	4.0	4.0	40.0
	231-591-2351	1	4.0	4.0	44.0
	269-327-7028 x110	1	4.0	4.0	48.0
	317-557-5125	1	4.0	4.0	52.0
	4255571624	1	4.0	4.0	56.0
	508-856-2498	1	4.0	4.0	60.0
	614-849-8560	1	4.0	4.0	64.0
	616 855-8521	1	4.0	4.0	68.0
	616-243-2752	1	4.0	4.0	72.0
	616-447-2803	1	4.0	4.0	76.0
	616-726-5025	1	4.0	4.0	80.0
	630-306-5998	1	4.0	4.0	84.0
	651-407-4255	1	4.0	4.0	88.0
	703-727-8344	1	4.0	4.0	92.0
	734-475-1148	1	4.0	4.0	96.0
	765-932-7293	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q8 Company name

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Air Systems Engineering, Inc	1	4.0	4.0	4.0
	American Univeristy	1	4.0	4.0	8.0
	Automated Logic - Twin Cities	1	4.0	4.0	12.0
	Bel-Aire Htg. & A/C, Inc.	1	4.0	4.0	16.0
	carrier corp	1	4.0	4.0	20.0
	Controlled Environmental Systems	1	4.0	4.0	24.0
	Emerson Climate Technologies, Retail Solutions	1	4.0	4.0	28.0
	EnerTemp, Inc.	1	4.0	4.0	32.0
	Evans Tempcon, Inc.	1	4.0	4.0	36.0
	Ferris	1	4.0	4.0	40.0
	Ford Motor Co.	1	4.0	4.0	44.0
	Heapy Engineering	1	4.0	4.0	48.0
	Johnson Controls, Inc.	1	4.0	4.0	52.0
	Krack Corp. A Division of Hussmann Corporation	1	4.0	4.0	56.0
	Liebert Capitol Office	1	4.0	4.0	60.0
	Meijer Inc.	1	4.0	4.0	64.0
	Nelson Trane	1	4.0	4.0	68.0
	Quality Air	1	4.0	4.0	72.0
	Ryder Holland Logistic Center	1	4.0	4.0	76.0
	Siemens Industry Inc.	1	4.0	4.0	80.0
	Siemens Industry, Inc.	1	4.0	4.0	84.0
	Synergy Consulting Engineers	1	4.0	4.0	88.0
	The Trane Company	1	4.0	4.0	92.0
	Trane (Ingersoll Rand)	1	4.0	4.0	96.0
	UMASS Medical School	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q9 Position Title

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Account Manager	1	4.0	4.0	4.0
	Application engineering Team Leader	1	4.0	4.0	8.0
	Area Programmer/ Engineering Specialist	1	4.0	4.0	12.0
	Chief Engineer	1	4.0	4.0	16.0
	Commercial Sales Manager	1	4.0	4.0	20.0
	Controls Engineer	1	4.0	4.0	24.0
	Design Engineer	1	4.0	4.0	28.0
	Director of Engineering	1	4.0	4.0	32.0
	Energy Engineer	2	8.0	8.0	40.0
	Energy Solutions Development Engineer	1	4.0	4.0	44.0
	Maintenance Manager	1	4.0	4.0	48.0
	Mechanical Project Engineer	1	4.0	4.0	52.0
	Midwest Regional Sales Manager	1	4.0	4.0	56.0
	Operations Manager	1	4.0	4.0	60.0
	Professor	1	4.0	4.0	64.0
	Project Engineer	2	8.0	8.0	72.0
	Quality Manager	1	4.0	4.0	76.0
	Regional Commissioning Manager	1	4.0	4.0	80.0
	Sales Engineer	1	4.0	4.0	84.0
	Senior Applications Engineer III	1	4.0	4.0	88.0
	Service Manager	1	4.0	4.0	92.0
	Stationary Steam Engineer	1	4.0	4.0	96.0
	Test Engineer	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q10 Company Address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	8.0	8.0	8.0
	1300 N. Benjamin Rushville, IN 46173	1	4.0	4.0	12.0
	1300 North Arlington Heights Rd Itasca, Illinois	1	4.0	4.0	16.0
	2121 Midway Road Suite 200, Carrolton, TX 75006	1	4.0	4.0	20.0
	22010 SE 51st ST. Issaquah, WA 98029	1	4.0	4.0	24.0
	2929 Walker Ave. Grand Rapids, MI	1	4.0	4.0	28.0
	3395 Kraft Ave SE Grand Rapids MI 49512	1	4.0	4.0	32.0
	3602 S Pine St Tacoma, WA 98409	1	4.0	4.0	36.0
	3850 Priority Way South Drive STE. 204 Indianapolis, Indiana 46240	1	4.0	4.0	40.0
	3961 Eastern Avenue, SE Grand Rapids, MI 49508	1	4.0	4.0	44.0
	4400 Massachusetts Ave. N.W. Washington, DC	1	4.0	4.0	48.0
	44611 Guilford Drive Suite 180 Ashburn, VA 20147	1	4.0	4.0	52.0
	449 Howard Ave Holland, MI 49424	1	4.0	4.0	56.0
	4833 White Bear Parkway St. Paul, MN 55110	1	4.0	4.0	60.0
	5335 Hill 23 Drive Flint, MI 48507	1	4.0	4.0	64.0
	55 Lake Ave Worcester MA, 01655	1	4.0	4.0	68.0
	605 S. Warren, Big Rapids, 49307	1	4.0	4.0	72.0
	6250 Jupiter Ave NE Suite B Belmont, MI 49306	1	4.0	4.0	76.0
	701 Ann St. NW Grand Rapids, MI 49504	1	4.0	4.0	80.0
	781 Lenox Ave. Portage, MI 49024	1	4.0	4.0	84.0
	835 Green Crest Dr. Westerville, OH 43081	1	4.0	4.0	88.0
	8940 Western Way Suite 1 Jacksonville, FL 32256	1	4.0	4.0	92.0
	Home office	1	4.0	4.0	96.0

q10 Company Address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Saint Paul, MN	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q11 E-mail Address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	adweleyi@yahoo.com	1	4.0	4.0	4.0
	Andrew.Doe@umassmed.edu	1	4.0	4.0	8.0
	andynurenberg@hotmail.com	1	4.0	4.0	12.0
	art.guzowski@emerson.com	1	4.0	4.0	16.0
	awilson@trane.com	1	4.0	4.0	20.0
	bennettrick@att.net	1	4.0	4.0	24.0
	brbanks@hotmail.com blaine.r.banks@jci.com	1	4.0	4.0	28.0
	cday@enertemp.com	1	4.0	4.0	32.0
	chris.korn@siemens.com	1	4.0	4.0	36.0
	davids@asei.wa	1	4.0	4.0	40.0
	ddrys@ford.com	1	4.0	4.0	44.0
	dewayne.collins@siemens.com	1	4.0	4.0	48.0
	feutzm@ferris.edu	1	4.0	4.0	52.0
	jallen@american.edu	1	4.0	4.0	56.0
	Jason.Eaton@qualityairinc.com	1	4.0	4.0	60.0
	jdchristoff@comcast.net	1	4.0	4.0	64.0
	kpatte@evanstempcon.com	1	4.0	4.0	68.0
	Matthew.Caruthers@Emerson.com	1	4.0	4.0	72.0
	mgilmour@belaire.com	1	4.0	4.0	76.0
	mikemaynard25@yahoo.com	1	4.0	4.0	80.0
	Myronramage@hotmail.com	1	4.0	4.0	84.0
	Neal.Betts@gmail.com	1	4.0	4.0	88.0
	Nicholasroush@gmail.com	1	4.0	4.0	92.0
	nickr@synergy-engineers.com	1	4.0	4.0	96.0
	philm@alctwincities.com	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q12 Industry need to increase number of students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	22	88.0	100.0	100.0
Missing	System	3	12.0		
Total		25	100.0		

q13 Number of faculty per students be increased

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	14	56.0	66.7	66.7
	No	7	28.0	33.3	100.0
	Total	21	84.0	100.0	
Missing	System	4	16.0		
Total		25	100.0		

q14 Last time you visited the HVAC building

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1992	1	4.0	4.0	4.0
	1997	1	4.0	4.0	8.0
	2001	1	4.0	4.0	12.0
	2002	1	4.0	4.0	16.0
	2003	1	4.0	4.0	20.0
	2005	3	12.0	12.0	32.0
	2007	1	4.0	4.0	36.0
	2008	1	4.0	4.0	40.0
	2009	4	16.0	16.0	56.0
	2010	4	16.0	16.0	72.0
	4 years	1	4.0	4.0	76.0
	5/2000	1	4.0	4.0	80.0
	September 2011	1	4.0	4.0	84.0
	several years ago, I can't remember exact date	1	4.0	4.0	88.0
	Since graduation	1	4.0	4.0	92.0
	Summer 2004	1	4.0	4.0	96.0
	today	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q15 Please indicate your initial salary range

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	$20,000 - $25,000	1	4.0	4.0	4.0
	$30,001 - $35,000	2	8.0	8.0	12.0
	$35,001 - $40,000	4	16.0	16.0	28.0
	$40,001 - $45,000	6	24.0	24.0	52.0
	$45,001 - $50,000	4	16.0	16.0	68.0
	More than $50,000	8	32.0	32.0	100.0
	Total	25	100.0	100.0	

q16 Please indicate your current salary range

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below $30,000	1	4.0	4.0	4.0
	$45,001 - $50,000	2	8.0	8.0	12.0
	$50,001 - $60,000	3	12.0	12.0	24.0
	$60,001 - $70,000	4	16.0	16.0	40.0
	More than $70,000	15	60.0	60.0	100.0
	Total	25	100.0	100.0	

q17 Most closely describes your daily activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Marketing/Sales	3	12.0	12.5	12.5
	HVACR Design	1	4.0	4.2	16.7
	Company Management/Ownership	2	8.0	8.3	25.0
	Performance	3	12.0	12.5	37.5
	Control Engineering	4	16.0	16.7	54.2
	Control Application Engineer	2	8.0	8.3	62.5
	Other	9	36.0	37.5	100.0
	Total	24	96.0	100.0	
Missing	System	1	4.0		
Total		25	100.0		

q17.a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		13	52.0	52.0	52.0
	Application Engineering (for Commercial and industrial refrigeration equipment)	1	4.0	4.0	56.0
	Bidding/Estimating, Marketing/Sales, Application Engineer, Design	1	4.0	4.0	60.0
	Commissioning Agent	1	4.0	4.0	64.0
	Commissioning/ Energy Services	1	4.0	4.0	68.0
	Energy Engineering	1	4.0	4.0	72.0
	Energy Savings Performance Contracting	1	4.0	4.0	76.0
	operations/support	1	4.0	4.0	80.0
	Plant Energy Engineer	1	4.0	4.0	84.0
	Project Manage/Engineer in all MEP applications including controls and Performance	1	4.0	4.0	88.0
	R&D / Sales Support / Application Engineering	1	4.0	4.0	92.0
	Teacher	1	4.0	4.0	96.0
	Warranty Prevention (Supplier / Design / Workmanship improvement project management)	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.a HVAC design courses are important to your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	17	68.0	68.0	68.0
	Agree	8	32.0	32.0	100.0
	Total	25	100.0	100.0	

q18.b Well prepared in the area of HVACR Design

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	15	60.0	62.5	62.5
	Agree	8	32.0	33.3	95.8
	Disagree	1	4.0	4.2	100.0
	Total	24	96.0	100.0	
Missing	System	1	4.0		
Total		25	100.0		

q18.c Use of CAD is important to your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	7	28.0	30.4	30.4
	Agree	6	24.0	26.1	56.5
	Neutral	4	16.0	17.4	73.9
	Disagree	3	12.0	13.0	87.0
	Strongly Disagree	3	12.0	13.0	100.0
	Total	23	92.0	100.0	
Missing	System	2	8.0		
Total		25	100.0		

q18.d Well prepared in the area of CAD

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	5	20.0	20.0	20.0
	Agree	6	24.0	24.0	44.0
	Neutral	7	28.0	28.0	72.0
	Disagree	5	20.0	20.0	92.0
	Strongly Disagree	1	4.0	4.0	96.0
	Not Applicable	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.e Ability to do a load calculation is important to your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	8	32.0	32.0	32.0
	Agree	7	28.0	28.0	60.0
	Neutral	7	28.0	28.0	88.0
	Disagree	2	8.0	8.0	96.0
	Strongly Disagree	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.f Well prepared in the area of load calculations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	10	40.0	40.0	40.0
	Agree	12	48.0	48.0	88.0
	Neutral	1	4.0	4.0	92.0
	Disagree	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

q18.g Equipment selection is an important part of your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	9	36.0	36.0	36.0
	Agree	7	28.0	28.0	64.0
	Neutral	6	24.0	24.0	88.0
	Disagree	2	8.0	8.0	96.0
	Strongly Disagree	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.h Well prepared in the area of equipment selection

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	12	48.0	48.0	48.0
	Agree	9	36.0	36.0	84.0
	Neutral	4	16.0	16.0	100.0
	Total	25	100.0	100.0	

q18.i Control theory is an important part of you job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	18	72.0	72.0	72.0
	Agree	6	24.0	24.0	96.0
	Disagree	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.j Well prepared in the area of control theory

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	12	48.0	48.0	48.0
	Agree	12	48.0	48.0	96.0
	Neutral	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.k Control application is an important part of your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	16	64.0	64.0	64.0
	Agree	7	28.0	28.0	92.0
	Neutral	1	4.0	4.0	96.0
	Disagree	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.l Well prepared in the area of control application

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	12	48.0	48.0	48.0
	Agree	9	36.0	36.0	84.0
	Neutral	3	12.0	12.0	96.0
	Disagree	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.m Ability to read a blue print is an important part of your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	20	80.0	80.0	80.0
	Agree	3	12.0	12.0	92.0
	Neutral	1	4.0	4.0	96.0
	Strongly Disagree	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.n Well prepared in the area of blue print reading

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	10	40.0	40.0	40.0
	Agree	7	28.0	28.0	68.0
	Neutral	4	16.0	16.0	84.0
	Disagree	4	16.0	16.0	100.0
	Total	25	100.0	100.0	

q18.o Ability to understand job specs is an important part of your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	18	72.0	72.0	72.0
	Agree	4	16.0	16.0	88.0
	Neutral	1	4.0	4.0	92.0
	Disagree	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

q18.p Well prepared to deal with job specifications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	9	36.0	36.0	36.0
	Agree	6	24.0	24.0	60.0
	Neutral	3	12.0	12.0	72.0
	Disagree	5	20.0	20.0	92.0
	Strongly Disagree	1	4.0	4.0	96.0
	Not Applicable	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.q Math is an important part of your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	17	68.0	68.0	68.0
	Agree	7	28.0	28.0	96.0
	Neutral	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.r Well prepared in the area of math

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	8	32.0	32.0	32.0
	Agree	11	44.0	44.0	76.0
	Neutral	4	16.0	16.0	92.0
	Disagree	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

q18.s Written communication skills is an important part of your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	20	80.0	80.0	80.0
	Agree	5	20.0	20.0	100.0
	Total	25	100.0	100.0	

q18.t Well prepared in the area of written communications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	11	44.0	44.0	44.0
	Agree	9	36.0	36.0	80.0
	Neutral	3	12.0	12.0	92.0
	Disagree	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

q18.u Verbal communication skills is an important part of your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	21	84.0	84.0	84.0
	Agree	4	16.0	16.0	100.0
	Total	25	100.0	100.0	

q18.v Well prepared in the area of verbal communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	8	32.0	32.0	32.0
	Agree	11	44.0	44.0	76.0
	Neutral	5	20.0	20.0	96.0
	Disagree	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.w Ability to troubleshoot is an important part of your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	20	80.0	80.0	80.0
	Agree	3	12.0	12.0	92.0
	Neutral	1	4.0	4.0	96.0
	Disagree	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.x Well prepared in the area of troubleshooting

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	15	60.0	60.0	60.0
	Agree	5	20.0	20.0	80.0
	Neutral	3	12.0	12.0	92.0
	Disagree	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

q18.y Energy audits are an important part of your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	7	28.0	28.0	28.0
	Agree	9	36.0	36.0	64.0
	Neutral	7	28.0	28.0	92.0
	Disagree	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

q18.z Well prepared to do an energy audit

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	7	28.0	28.0	28.0
	Agree	14	56.0	56.0	84.0
	Neutral	3	12.0	12.0	96.0
	Disagree	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.aa Ability to commission an HVAC system is an important part of your job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	14	56.0	56.0	56.0
	Agree	6	24.0	24.0	80.0
	Neutral	3	12.0	12.0	92.0
	Disagree	1	4.0	4.0	96.0
	Strongly Disagree	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.ab Well prepared to commission HVAC equipment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	24.0	24.0	24.0
	Agree	14	56.0	56.0	80.0
	Neutral	3	12.0	12.0	92.0
	Disagree	1	4.0	4.0	96.0
	Not Applicable	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.ac Overall, well prepared for the job that you are doing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	10	40.0	40.0	40.0
	Agree	14	56.0	56.0	96.0
	Neutral	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.ad The advising was adequate in the HVAC program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	11	44.0	44.0	44.0
	Agree	10	40.0	40.0	84.0
	Neutral	2	8.0	8.0	92.0
	Disagree	2	8.0	8.0	100.0
	Total	25	100.0	100.0	

q18.ae The placement services were adequate at Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	7	28.0	28.0	28.0
	Agree	5	20.0	20.0	48.0
	Neutral	7	28.0	28.0	76.0
	Disagree	6	24.0	24.0	100.0
	Total	25	100.0	100.0	

q18.af The mix of technical/social & cultural courses were adequate

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	5	20.0	20.0	20.0
	Agree	15	60.0	60.0	80.0
	Neutral	4	16.0	16.0	96.0
	Disagree	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q18.ag You had no problem finding a job after graduation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	16	64.0	66.7	66.7
	Agree	7	28.0	29.2	95.8
	Neutral	1	4.0	4.2	100.0
	Total	24	96.0	100.0	
Missing	System	1	4.0		
Total		25	100.0		

q18.ah You were able to be productive in your job right out of school

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	13	52.0	52.0	52.0
	Agree	12	48.0	48.0	100.0
	Total	25	100.0	100.0	

q18.ai There is a high demand for the HVACR-4 year graduate

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	14	56.0	56.0	56.0
	Agree	8	32.0	32.0	88.0
	Neutral	2	8.0	8.0	96.0
	Not Applicable	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

q19 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	20.0	20.0	20.0
	A lot of the training on load calcs and equipment selection were way to vague and abstract. For example find an AHU with this coil and this static pressure, but the reasons behind the selections were not covered adequately. This also applies, boilers, chillers, energy recovery units, heat pumps, etc. Also more time should spent on geothermal systems and every type of energy recovery system. And detail and theory is helpful. This kind of equipment is being so commonplace that it can't be glossed over. These days it rare to not see a "green system" for lack of a better term.	1	4.0	4.0	24.0
	AutoCad Training, Bim, TSI, These are going to become very important parts of doing the Design Engineering Jobs. Designing the most Green/energy efficient system is the way of the future. Thinking outside the box.	1	4.0	4.0	28.0
	Control programming	1	4.0	4.0	32.0
	Controls Classes need to include some IT networking, very important in today's control systems. Math-need to add the additional math classes needed to make it a "true" engineering degree if possible. Need to offer a Basic Sales and Marketing class if possible as an option	1	4.0	4.0	36.0
	Early internships are critical. The sooner the students can get out in the field during their educational process the better. I feel their dedication to learning, knowledge gained and aclaimation to their respective industry(s) will increase expediously.	1	4.0	4.0	40.0

q19 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I believe with the current increased focus on energy management, energy auditing, and commissioning, the course curriculum should provide a means for students to obtain one of the practitioner in training certification through AEE (Association of Energy Engineers) (e.g. EMIT - Energy Manager in Training or CEAIT - Certified Energy Auditor in Training). Also, in addition to the student ASHRAE chapter (which I believe to be a great resource) a student AEE chapter should be started as well. I believe that the program produces strong professionals who have skills that are much needed in the energy engineering sector. I have found the Ferris HVACR program is well known to persons in the control and HVAC service industries but not as much in the energy engineering sector. Most A/E firms are struggling with finding skilled personnel that have the capability to understand the design of HVACR systems and are capable of trouble shooting them to improve their performance.	1	4.0	4.0	44.0
	I have had a lot of companies that ask why the program does not lead to a PE. Although, it has not set me back, it might have if i did not have working expierence.	1	4.0	4.0	48.0
	I still reference coursework folders from classes at Ferris, specifically my HVAC classes. One important thing is to continuously challenge the students, either through tougher core curriculum, or the addition of challenging math or physics courses. CAD is not as important to me, but a great option would be a class for building modeling (BIM, eQuest, etc.) This is a skill set that would put any graduate at a competitive advantage for jobs in several HVAC industries.	1	4.0	4.0	52.0
	I think the program lacks financial training from a project management standpoint.	1	4.0	4.0	56.0
	I would suggest higher level of math courses (such as calculus) and transform the current engineering technology program into a full-engineering program; that is, BS Degree in HVACR Engineering.	1	4.0	4.0	60.0

q19 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	In the early '90s, I was fortunate to have benefited from some of the finest design professionals who were also professors. I have a sense that the program has slipped in the teaching of sound fundamental systems, design, and controls principles, relying instead on forcing the popular "design du jour" on students for the sake of program recognition. I have evidence to suggest my theory is correct based on recent hires here at EnerTemp.	1	4.0	4.0	64.0
	its been 15 years since I was there so I don't know how out of date this info. might be. I say keep up the good work and keep doing more. we are still looking for coops if you still have that program. I know Mass. is a long way, but we could use what is learned there here at our Facility.	1	4.0	4.0	68.0
	More emphasis on industrial boilers, water treatment, chillers, HVAC etc. Thanks!	1	4.0	4.0	72.0
	Prior to going to Ferris State University I was working as a field service technician for a small residential company and had not future room for growth or real knowledge of how large the HVACR industry actually was. Fortunately, I found Ferris State Universities HVACR program on line and made a phone call to talk about the program and career opportunities that waited for me once I graduated. Since my graduation I have worked and had my career grow in Marketing, Technical Service, Product Support, Manufacturing Engineering, and now Quality Management. Each of these rolls has been within the same company (Trane). As stated above, prior to Ferris State my options were limited and knowledge of other areas in the HVACR field. The positions that I have been in are not the only areas where HVACR degreed Ferris Students can impact. Other areas are Contracting, Sales, Distribution, Design, Product Management, Engineering, etc..... The opportunities exist! Had it not been for Ferris State University, Its Professors, and the HVACR program I would be no where near the compensation level or have the industry experience, and knowledge that I have today.	1	4.0	4.0	76.0

q19 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Put more empahasis in 4 year program on the "R" portion of HVACR. All of above questions address only HVAC. Consider optional advanced classes in commercial & industrial refrigeration load calcs, equipment selection along with refrigeration controls. Partner with industry companies such as Emerson's Copeland Corporation, Vilter, and CPC.	1	4.0	4.0	80.0
	Stronger writing skills should be a requirement	1	4.0	4.0	84.0

q19 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	The HVACR program is one of the most relevant courses of study in the United States. Two recent studies conducted by faculty found that both AAS and BS graduates received education that exactly targeted the areas they needed on the job. When I was a student, I thought the BS program was most organized and very well thought-out. It seemed to cover all aspects of design, equipment selection, control and energy analysis of HVAC systems. In other words, everything that one would need in the industry was included in the program. Now that I am faculty and have conducted two studies of my own, reviewed two prior APR reports, and read a study by another one of our faculty, I know that my perceptions as a student were accurate. The HVACR progams continue to be exactly where they need to be. A recent curriculum change took place to strengthen both the AAS and the BS programs. My dissertation found that the addition of HVAC 350 was sorely needed by graduates, and my subjects were h appy to hear that the course had already been implemented. Their feedback verified our conclusion that the course was needed. Within our industry, Ferris State is at the pinnacle. The HVACR students have dominated the ASHRAE student competition for years. No other school in the world has the record that Ferris holds. ASHRAE sets the standards for mechanical system design, energy efficiency, and human comfort for the United States and other countries. The competition is international in scope. There is not a more “industry-targeted” competition available, and not a better measure of academic relevance. As a faculty member, I know that my perception of the HVACR programs is taken with a grain of salt. After all, what faculty would not brag up his or her program? But all one would need to do is travel with us as we attend national events. They could see first-hand how impressed the industry is with HVACR at Ferris, they just might begin to appreciate what an as set HVACR is to the university. From my perspective as a faculty member who is nationally involved with employers of our graduates - mechanical contractors, I know that there has never been an academic program that is more “right” when it comes to preparing students for a successful career. I am thankful and proud to be a faculty member of the HVACR program.	1	4.0	4.0	88.0

q19 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	The largest detriment to the HVACR program is the graduates not being able to take the P.E. exam, this has hindered my career and changed the course of jobs pursued.	1	4.0	4.0	92.0
	The Math and Physics ought to be calculus based. The ability to get a PE would be ideal	1	4.0	4.0	96.0
	There should be an energy analytics course. This is the only item that I felt was lacking in my education at Ferris.	1	4.0	4.0	100.0
	Total	25	100.0	100.0	

FERRIS STATE UNIVERSITY
COLLEGE OF TECHNOLOGY
CONSTRUCTION DEPARTMENT
HVACR PROGRAMS

February 1, 2012

Dear Ferris HVACR Graduate Employer:

Ferris State University Could Enhance the HVACR Programs! We Need YOUR Input!

The University's Academic Program review Committee is reviewing our HVACR Programs. As a employer of Ferris State University HVACR program graduates, we need your viewpoint! The results of this review can range from increasing our programs' resources, to placing the program in a probationary status. This process requires your **input!**

This review process is also important in making changes to the HVACR curriculum in order to improve the quality of the graduate we turn out. You can help us keep the HVACR programs at a high level of quality by completing the enclosed survey and returning it by **March 15, 2012**. Again, your input regarding the HVACR programs and its' graduates is vital to the continued success of this program. Note: Two surveys were included so that one could be filled out relating to a two year graduate and one survey could be filled out regarding a four year graduate if you employ both. Please note on the survey which type of graduate you are responding to.

Note: The result of the last program review in 2000 resulted in a **new building for the HVACR Programs**, your input is taken very seriously by the university!

In advance, we thank you for your quick response.

Sincerely,

Douglas F Zentz
Associate Professor
HVACR Programs Coordinator

Enclosed: Graduate Employer Survey

FERRIS STATE UNIVERSITY
HVACR Program Review
Employer Perception of the HVACR Programs

EMPLOYER SURVEY

Name:_________________________________ Title:_________________________________

Company Name:_________________________ Types of Ferris Graduates Employed?

Address:_______________________________ Associate Degree ❐

_______________________________________ Bachelor Degree ❐

Indicate the approximate number of Ferris HVACR graduates employed by your company:____________________

Competencies & Foundation Skills:	Excellent	Good	Acceptable	Below Expectations	Poor	Not Applicable
	E	G	A	BE	P	NA
1 Uses written and oral communication skills effectively	5	4	3	2	1	NA
2 Possesses adequate overall technical skills in HVACR	5	4	3	2	1	NA
3 Possesses adequate mathematical skills	5	4	3	2	1	NA
4 Uses critical thinking, problem solving and decision making skills	5	4	3	2	1	NA
5 Exhibits an appropriate level of responsibility and self management	5	4	3	2	1	NA
6 Chooses ethical courses of action	5	4	3	2	1	NA
7 Identifies, organizes, plans, and allocates resources	5	4	3	2	1	NA
8 Participates as a team player	5	4	3	2	1	NA
9 Works well with individuals from diverse backgrounds	5	4	3	2	1	NA
10 Acquires, interprets and uses information effectively	5	4	3	2	1	NA
11 Possesses the ability to gain rapport with clients	5	4	3	2	1	NA
12 Uses technologies effectively (computer, telecommunications, etc)	5	4	3	2	1	NA
13 Possesses leadership and negotiation skills	5	4	3	2	1	NA
14 Ability to read and interpret blueprints	5	4	3	2	1	NA
15 Ability to use and apply job specifications	5	4	3	2	1	NA
16 Recognize and understand all HVACR systems	5	4	3	2	1	NA
17 Knowledge of control theory and terminology	5	4	3	2	1	NA
18 Understand and develop electrical and control schematics	5	4	3	2	1	NA
19 Ability to troubleshoot a single simple HVACR system	5	4	3	2	1	NA
20 Ability to troubleshoot a complex or multiple HVACR systems	5	4	3	2	1	NA
21 Understand HVACR safety sequences	5	4	3	2	1	NA
22 Ability to work on CAD	5	4	3	2	1	NA
23 Ability to develop an HVACR bid	5	4	3	2	1	NA
24 Ability to commission an HVACR system after install or repair	5	4	3	2	1	NA
25 Ability to install HVACR components or systems	5	4	3	2	1	NA
26 Understands the importance of time management	5	4	3	2	1	NA
27 Completes a job with minimal re-work	5	4	3	2	1	NA
28 Understands HVACR codes, standards and regulations	5	4	3	2	1	NA

EMPLOYER SURVEY

In the space below, you can make detailed comments on the previous page of evaluation or add comments on specific program concerns including program strengths, weaknesses, areas for improvement, action required to achieve improvement, etc.

11Sp Grad Exit...AAS HVACR Tech

Frequencies

Prepared by: Institutional Research & Testing, 09/11

Statistics

	N		Mean	Median
	Valid	Missing		
q15 I entered Ferris	1	0	8.00	8.00
q15a Other specified	1	0		
q16 Other degrees earned before coming to Ferris	1	0		
q17 Last high school/college attended prior to Ferris	1	0		
q18_1 Learn: HS teacher/Counselor	1	0	.00	.00
q18_2 Learn: Voc/Tech school teacher/Counselor	1	0	.00	.00
q18_3 Learn: While attending another program at FSU	1	0	.00	.00
q18_4 Learn: From advisor at another college	1	0	.00	.00
q18_5 Learn: From visit by FSU faculty at other college	1	0	.00	.00
q18_6 Learn: General marketing, bill boards, etc.	1	0	1.00	1.00
q18_7 Learn: Site tour of high school students	1	0	.00	.00
q18_8 Learn: Other	1	0	1.00	1.00
q18a Other specified	1	0		
q19 Which Ferris program did you transfer from	1	0		
q20 Why did you switch programs	1	0		
q21_1 Format: On-line	1	0	.00	.00
q21_2 Format: Main campus (face-to-face)	1	0	1.00	1.00
q21_3 Format: Off-campus (face-to-face)	1	0	.00	.00
q21_4 Format: Non-Ferris face-to-face	1	0	.00	.00
q21_5 Format: Non-Ferris on-line	1	0	.00	.00
q22 Format do you prefer	1	0	1.00	1.00
q23 Please explain why you prefer that format	1	0		
q24 When did you first start at Ferris	1	0		
q25a Appropriate mastery of the techniques, skills, and tools	1	0	5.00	5.00
q25b Good critical thinking, problem solving & decision making skills	1	0	5.00	5.00
q25c Strong technical understanding of my field	1	0	5.00	5.00
q25d Ability to apply technical theory to practical situations	1	0	5.00	5.00
q25e Self-motivation & enthusiasm for my chosen profession	1	0	5.00	5.00
q25f Oral & writing skills necessary to communicate effectively	1	0	5.00	5.00
q25g Prepared and able to assume responsibility	1	0	5.00	5.00

Statistics

	N		Mean	Median
	Valid	Missing		
q25h Provided adequate social awareness courses	1	0	5.00	5.00
q25aa Effectively used available resources from my program	1	0	5.00	5.00
q25i Worked well with individuals with diverse backgrounds	1	0	5.00	5.00
q25j Commitment to quality, timeliness, continuous improvement	1	0	5.00	5.00
q25k Good ethical values	1	0	5.00	5.00
q25l Challenged intellectually by my courses	1	0	5.00	5.00
q25m Motivated to a higher level of performance	1	0	5.00	5.00
q25n Design and conduct experiments, as well as to analyze and interpret data	0	1		
q25o Design a system, component, or process to meet desired needs within realistic constraints	0	1		
q25p Broad education necessary to understand the impact of technical/engineering solutions	0	1		
q25q Function effectively on (multidisciplinary) teams	1	0	5.00	5.00
q25r Identify, formulate, analyze and solve technical or engineering problems	1	0	5.00	5.00
q25s Recognized the need for life-long learning	1	0	5.00	5.00
q25t Understand professional, ethical and social responsibilities	1	0	5.00	5.00
q25u Apply current knowledge and adapt to emerging applications	1	0	5.00	5.00
q25v Conduct, analyze and interpret experiments, and apply experimental results	1	0	5.00	5.00
q25w Apply creativity in the design of systems, components, or processes	1	0	5.00	5.00
q25x Respect for diversity and knowledge of contemporary professional, societal and global issues	1	0	5.00	5.00
q25y Provided by my program a good mix of courses for my career options	1	0	5.00	5.00
q25z Provided adequate technical content courses by my program	1	0	5.00	5.00
q26a Overall mastery of subject matter	1	0	4.00	4.00
q26b Adequate instruction in the classroom	1	0	4.00	4.00
q26c Involved in my education process inside the classroom	1	0	4.00	4.00
q26d Involved in my education process outside the classroom	1	0	4.00	4.00
q26e Accessible for advising	1	0	4.00	4.00
q26f Helpful in advising	1	0	4.00	4.00

Statistics

	N		Mean	Median
	Valid	Missing		
q27a Curriculum is current for my industry/profession	1	0	4.00	4.00
q27b Overall quality of the labs & hands-on components were relevant	1	0	4.00	4.00
q27c Rate the quality of my curriculum as good	1	0	4.00	4.00
q28 Required an internship experience	0	1		
q29 The internship experience was an important aspect	0	1		
q30a Classrooms provide a good learning environment	1	0	4.00	4.00
q30b Equipment & supplies were available and maintained	1	0	4.00	4.00
q30c Lab equipment was representative	1	0	4.00	4.00
q30d Instructional lab facilities were in good condition	1	0	4.00	4.00
q31a Experiences other than coursework were valuable part of my education	1	0	4.00	4.00
q31b Guest speakers were a valuable part of my education	1	0	4.00	4.00
q31c Adequate learning resources were available	1	0	4.00	4.00
q31d My overall campus experience was satisfying	1	0	4.00	4.00
q31e I would recommend my program to others	1	0	4.00	4.00
q31f I would be interested in working to advance my program at FSU	1	0	4.00	4.00
q31g Overall, I am very satisfied with my education at FSU	1	0	4.00	4.00
q32 Overall campus experience was satisfying (why/why not)	1	0		
q33 Recommend your program to others (why/why not)	1	0		
q34 I was a student member of at least one industry/professional organization	1	0	1.00	1.00
q35 Do you believe your membership helpful	1	0	2.00	2.00
q36 I participated in other campus/community organizations	1	0	2.00	2.00
q37 I served in a leadership position for a student or industry/professional organization	0	1		
q38 Do you believe your leadership position helpful	0	1		
q39 Were you made aware of and apply for scholarship opportunities	1	0	2.00	2.00
q40a Study Abroad	1	0	2.00	2.00
q40b Internship Abroad	1	0	2.00	2.00
q40c I did participate in the Internship Abroad program	1	0	2.00	2.00

Statistics

	N		Mean	Median
	Valid	Missing		
q41_1 Limited: Funding	1	0	1.00	1.00
q41_2 Limited: Time	1	0	1.00	1.00
q41_3 Limited: Personal obligations	1	0	1.00	1.00
q41_4 Limited: Military obligations	1	0	.00	.00
q41_5 Limited: Lack of FSU "Gen-Ed" credit/recognition	1	0	.00	.00
q41_6 Limited: Professional obligations	1	0	.00	.00
q41_7 Limited: Not interested	1	0	1.00	1.00
q42 Currently or upon graduation, I plan to or have	1	0	2.00	2.00
q42a Other specified	1	0		
q43_1 Tools: FSU's Career Placement Services	1	0	1.00	1.00
q43_2 Tools: Ferris Job Fairs	1	0	1.00	1.00
q43_3 Tools: Internship	1	0	.00	.00
q43_4 Tools: Word-of-mouth	1	0	1.00	1.00
q43_5 Tools: Newspaper	1	0	1.00	1.00
q43_6 Tools: On-line	1	0	1.00	1.00
q43_7 Tools: Not actively seeking employment	1	0	.00	.00
q43_8 Tools: Other	1	0	.00	.00
q43a Other specified	1	0		
q44 How did you hear of Career Placement Services	1	0	2.00	2.00
q44a Other specified	1	0		
q45 My starting salary (without benefits) after graduation	0	1		
q46_1 Flexible: rural areas	1	0	.00	.00
q46_2 Flexible: metropolitan areas	1	0	.00	.00
q46_3 Flexible: outside West Michigan	1	0	.00	.00
q46_4 Flexible: outside Michigan	1	0	.00	.00
q46_5 Flexible: outside the Midwest area	1	0	.00	.00
q46_6 Flexible: Internationally	1	0	.00	.00
q46_7 Flexible: anywhere	1	0	1.00	1.00
q47 Believe your technical education at FSU has adequately prepared you	1	0	1.00	1.00
q48 In what area(s) was your technical education lacking	1	0		
q49 Best describes your new position	0	1		
q49a Other specified	1	0		
q50 Type of industry your employer/business serves	0	1		
q50a Other specified	1	0		
q51a Computer networking/Communications	1	0	4.00	4.00

Statistics

	N		Mean	Median
	Valid	Missing		
q51b Computer programming/Control	1	0	4.00	4.00
q51c Database	1	0	3.00	3.00
q51d Office/Technical computer application software	1	0	3.00	3.00
q51e Business knowledge	1	0	3.00	3.00
q51f Hands-on skills	1	0	4.00	4.00
q51g Leadership	1	0	3.00	3.00
q51h Problem-solving	1	0	3.00	3.00
q51i Teamwork skills	1	0	3.00	3.00
q51j Technical knowledge	1	0	3.00	3.00
q51k Interpersonal communication	1	0	3.00	3.00
q51l Public speaking communication	1	0	3.00	3.00
q51m Written communication	1	0	3.00	3.00
q51n Management skills	1	0	3.00	3.00
q51o Marketing & Sales	1	0	3.00	3.00
q51p Mathematics	1	0	3.00	3.00
q51q Physics/Chemistry/Science	1	0	3.00	3.00
q51r Quality Assurance/Control	1	0	3.00	3.00
q52 Additional comments	1	0		

Frequency Table

q15 I entered Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Other	1	100.0	100.0	100.0

q15a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	After a job loss due to outsourcing	1	100.0	100.0	100.0

q16 Other degrees earned before coming to Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Certificate in Supply Chain Management	1	100.0	100.0	100.0

q17 Last high school/college attended prior to Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Michigan State University	1	100.0	100.0	100.0

q18_1 Learn: HS teacher/Counselor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q18_2 Learn: Voc/Tech school teacher/Counselor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q18_3 Learn: While attending another program at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q18_4 Learn: From advisor at another college

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q18_5 Learn: From visit by FSU faculty at other college

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q18_6 Learn: General marketing, bill boards, etc.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q18_7 Learn: Site tour of high school students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q18_8 Learn: Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q18a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Michigan Works Work Coordinator	1	100.0	100.0	100.0

q19 Which Ferris program did you transfer from

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	100.0	100.0	100.0

q20 Why did you switch programs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	100.0	100.0	100.0

q21_1 Format: On-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q21_2 Format: Main campus (face-to-face)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q21_3 Format: Off-campus (face-to-face)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q21_4 Format: Non-Ferris face-to-face

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q21_5 Format: Non-Ferris on-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q22 Format do you prefer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Face-to-face	1	100.0	100.0	100.0

q23 Please explain why you prefer that format

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I feel as though I am a hands on face to face learner - I feel that being in front of someone where you can instantly ask questions and get answers better fits my learning styles	1	100.0	100.0	100.0

q24 When did you first start at Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Summer 2009	1	100.0	100.0	100.0

q25a Appropriate mastery of the techniques, skills, and tools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25b Good critical thinking, problem solving & decision making skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25c Strong technical understanding of my field

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25d Ability to apply technical theory to practical situations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25e Self-motivation & enthusiasm for my chosen profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25f Oral & writing skills necessary to communicate effectively

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25g Prepared and able to assume responsibility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25h Provided adequate social awareness courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25aa Effectively used available resources from my program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25i Worked well with individuals with diverse backgrounds

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25j Commitment to quality, timeliness, continuous improvement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25k Good ethical values

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25l Challenged intellectually by my courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25m Motivated to a higher level of performance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25n Design and conduct experiments, as well as to analyze and interpret data

		Frequency	Percent
Missing	System	1	100.0

q25o Design a system, component, or process to meet desired needs within realistic constraints

		Frequency	Percent
Missing	System	1	100.0

q25p Broad education necessary to understand the impact of technical/engineering solutions

		Frequency	Percent
Missing	System	1	100.0

q25q Function effectively on (multidisciplinary) teams

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25r Identify, formulate, analyze and solve technical or engineering problems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25s Recognized the need for life-long learning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25t Understand professional, ethical and social responsibilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25u Apply current knowledge and adapt to emerging applications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25v Conduct, analyze and interpret experiments, and apply experimental results

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25w Apply creativity in the design of systems, components, or processes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25x Respect for diversity and knowledge of contemporary professional, societal and global issues

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25y Provided by my program a good mix of courses for my career options

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q25z Provided adequate technical content courses by my program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q26a Overall mastery of subject matter

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q26b Adequate instruction in the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q26c Involved in my education process inside the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q26d Involved in my education process outside the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q26e Accessible for advising

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q26f Helpful in advising

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q27a Curriculum is current for my industry/profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q27b Overall quality of the labs & hands-on components were relevant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q27c Rate the quality of my curriculum as good

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q28 Required an internship experience

		Frequency	Percent
Missing	System	1	100.0

q29 The internship experience was an important aspect

		Frequency	Percent
Missing	System	1	100.0

q30a Classrooms provide a good learning environment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q30b Equipment & supplies were available and maintained

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q30c Lab equipment was representative

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q30d Instructional lab facilities were in good condition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q31a Experiences other than coursework were valuable part of my education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q31b Guest speakers were a valuable part of my education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q31c Adequate learning resources were available

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q31d My overall campus experience was satisfying

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q31e I would recommend my program to others

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q31f I would be interested in working to advance my program at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q31g Overall, I am very satisfied with my education at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	100.0	100.0	100.0

q32 Overall campus experience was satisfying (why/why not)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	100.0	100.0	100.0

q33 Recommend your program to others (why/why not)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	It is a very strong and distinguished program and I feel that the program is great	1	100.0	100.0	100.0

q34 I was a student member of at least one industry/professional organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	100.0	100.0	100.0

q35 Do you believe your membership helpful

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	100.0	100.0	100.0

q36 I participated in other campus/community organizations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	100.0	100.0	100.0

q37 I served in a leadership position for a student or industry/professional organization

		Frequency	Percent
Missing	System	1	100.0

q38 Do you believe your leadership position helpful

		Frequency	Percent
Missing	System	1	100.0

q39 Were you made aware of and apply for scholarship opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	100.0	100.0	100.0

q40a Study Abroad

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	100.0	100.0	100.0

q40b Internship Abroad

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	100.0	100.0	100.0

q40c I did participate in the Internship Abroad program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	100.0	100.0	100.0

q41_1 Limited: Funding

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q41_2 Limited: Time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q41_3 Limited: Personal obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q41_4 Limited: Military obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q41_5 Limited: Lack of FSU "Gen-Ed" credit/recognition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q41_6 Limited: Professional obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q41_7 Limited: Not interested

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q42 Currently or upon graduation, I plan to or have

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not received a job offer yet	1	100.0	100.0	100.0

q42a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	100.0	100.0	100.0

q43_1 Tools: FSU's Career Placement Services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q43_2 Tools: Ferris Job Fairs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q43_3 Tools: Internship

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q43_4 Tools: Word-of-mouth

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q43_5 Tools: Newspaper

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q43_6 Tools: On-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q43_7 Tools: Not actively seeking employment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q43_8 Tools: Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q43a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	100.0	100.0	100.0

q44 How did you hear of Career Placement Services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Word of mouth	1	100.0	100.0	100.0

q44a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	100.0	100.0	100.0

q45 My starting salary (without benefits) after graduation

		Frequency	Percent
Missing	System	1	100.0

q46_1 Flexible: rural areas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q46_2 Flexible: metropolitan areas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q46_3 Flexible: outside West Michigan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q46_4 Flexible: outside Michigan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q46_5 Flexible: outside the Midwest area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q46_6 Flexible: Internationally

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	100.0	100.0	100.0

q46_7 Flexible: anywhere

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	1	100.0	100.0	100.0

q47 Believe your technical education at FSU has adequately prepared you

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	100.0	100.0	100.0

q48 In what area(s) was your technical education lacking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	100.0	100.0	100.0

q49 Best describes your new position

		Frequency	Percent
Missing	System	1	100.0

q49a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	100.0	100.0	100.0

q50 Type of industry your employer/business serves

		Frequency	Percent
Missing	System	1	100.0

q50a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	100.0	100.0	100.0

q51a Computer networking/Communications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Critical	1	100.0	100.0	100.0

q51b Computer programming/Control

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Critical	1	100.0	100.0	100.0

q51c Database

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51d Office/Technical computer application software

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51e Business knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51f Hands-on skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Critical	1	100.0	100.0	100.0

q51g Leadership

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51h Problem-solving

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51i Teamwork skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51j Technical knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51k Interpersonal communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51l Public speaking communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51m Written communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51n Management skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51o Marketing & Sales

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51p Mathematics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51q Physics/Chemistry/Science

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q51r Quality Assurance/Control

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	1	100.0	100.0	100.0

q52 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	100.0	100.0	100.0

12Sp CET Grad...AAS HVACR Tech

Frequencies

Prepared by: Institutional Research & Testing, 06/12

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q15 I entered Ferris	2	0	2.00	2.00	1.414
q15a Other specified	2	0			
q16 Other degrees earned before coming to Ferris	2	0			
q17 Last high school/college attended prior to Ferris	2	0			
q18_1 Learn: HS teacher/Counselor	2	0	.00	.00	.000
q18_2 Learn: Voc/Tech school teacher/Counselor	2	0	.50	.50	.707
q18_3 Learn: While attending another program at FSU	2	0	.00	.00	.000
q18_4 Learn: From advisor at another college	2	0	.00	.00	.000
q18_5 Learn: From visit by FSU faculty at other college	2	0	.00	.00	.000
q18_6 Learn: General marketing, bill boards, etc.	2	0	.00	.00	.000
q18_7 Learn: Site tour of high school students	2	0	.00	.00	.000
q18_8 Learn: Other	2	0	.50	.50	.707
q18a Other specified	2	0			
q19 Which Ferris program did you transfer from	2	0			
q20 Why did you switch programs	2	0			
q21_1 Format: On-line	2	0	.00	.00	.000
q21_2 Format: Main campus (face-to-face)	2	0	1.00	1.00	.000
q21_3 Format: Off-campus (face-to-face)	2	0	.00	.00	.000
q21_4 Format: Non-Ferris face-to-face	2	0	.00	.00	.000
q21_5 Format: Non-Ferris on-line	2	0	.00	.00	.000
q22 Format do you prefer	2	0	1.00	1.00	.000
q23 Why you prefer that format	2	0			
q24 When did you first start at Ferris	2	0			
q25a Appropriate mastery of the techniques, skills, and tools	2	0	4.00	4.00	.000
q25b Good critical thinking, problem solving & decision making skills	2	0	4.00	4.00	.000
q25c Strong technical understanding of my field	2	0	4.00	4.00	.000
q25d Ability to apply technical theory to practical situations	2	0	4.00	4.00	.000
q25e Self-motivation & enthusiasm for my chosen profession	2	0	4.00	4.00	.000
q25f Oral & writing skills necessary to communicate effectively	2	0	4.00	4.00	.000
q25g Prepared and able to assume responsibility	2	0	4.00	4.00	.000

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q25h Provided adequate social awareness courses	2	0	4.00	4.00	.000
q25i Effectively used available resources from my program	2	0	4.00	4.00	.000
q25j Worked well with individuals with diverse backgrounds	2	0	4.50	4.50	.707
q25k Commitment to quality, timeliness, continuous improvement	2	0	4.00	4.00	.000
q25l Good ethical values	2	0	4.50	4.50	.707
q25m Challenged intellectually by my courses	2	0	4.00	4.00	.000
q25n Motivated to a higher level of performance	1	1	4.00	4.00	
q25o Design and conduct experiments, as well as to analyze and interpret data	0	2			
q25p Design a system, component, or process to meet desired needs within realistic constraints	0	2			
q25q Broad education necessary to understand the impact of technical/engineering solutions	0	2			
q25r Function effectively on (multidisciplinary) teams	1	1	4.00	4.00	
q25s Identify, formulate, analyze and solve technical or engineering problems	2	0	4.00	4.00	.000
q25t Recognized the need for life-long learning	2	0	4.00	4.00	.000
q25u Understand professional, ethical and social responsibilities	2	0	4.00	4.00	.000
q25v Apply current knowledge and adapt to emerging applications	2	0	4.00	4.00	.000
q25w Conduct, analyze and interpret experiments, and apply experimental results	2	0	4.00	4.00	.000
q25x Apply creativity in the design of systems, components, or processes	2	0	4.00	4.00	.000
q25y Respect for diversity and knowledge of contemporary professional, societal and global issues	2	0	4.00	4.00	.000
q25z Provided a good mix of courses for my career options	2	0	4.00	4.00	.000
q25aa Provided adequate technical content courses by my program	2	0	4.00	4.00	.000
q26a Overall mastery of subject matter	2	0	3.50	3.50	.707
q26b Adequate instruction in the classroom	2	0	3.50	3.50	.707
q26c Involved in my education process inside the classroom	2	0	3.50	3.50	.707
q26d Involved in my education process outside the classroom	2	0	3.50	3.50	.707

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q26e Accessible for advising	2	0	3.50	3.50	.707
q26f Helpful in advising	2	0	3.50	3.50	.707
q27a Curriculum is current for my industry/profession	2	0	3.50	3.50	.707
q27b Overall quality of the labs & hands-on components were relevant	1	1	4.00	4.00	
q27c Rate the quality of my curriculum as good	2	0	3.00	3.00	.000
q28 Required an internship experience	2	0	2.00	2.00	.000
q29 The internship experience was an important aspect	0	2			
q30a Classrooms provide a good learning environment	2	0	3.50	3.50	.707
q30b Equipment & supplies were available and maintained	2	0	3.50	3.50	.707
q30c Lab equipment was representative	2	0	3.50	3.50	.707
q30d Instructional lab facilities were in good condition	2	0	3.50	3.50	.707
q31a Experiences other than coursework were valuable part of my education	2	0	3.00	3.00	.000
q31b Guest speakers were a valuable part of my education	2	0	3.00	3.00	.000
q31c Adequate learning resources were available	2	0	3.00	3.00	.000
q31d My overall campus experience was satisfying	2	0	3.00	3.00	.000
q31e I would recommend my program to others	2	0	3.00	3.00	.000
q31f I would be interested in working to advance my program at FSU	2	0	3.00	3.00	.000
q31g Overall, I am very satisfied with my education at FSU	1	1	3.00	3.00	
q32 Overall campus experience was satisfying (why/why not)	2	0			
q33 Recommend your program to others (why/why not)	2	0			
q34 I was a student member of at least one industry/professional organization	2	0	1.50	1.50	.707
q35 Do you believe your membership helpful	1	1	1.00	1.00	
q36 I participated in other campus/community organizations	2	0	1.50	1.50	.707
q37 I served in a leadership position for a student or industry/professional organization	1	1	2.00	2.00	
q38 Do you believe your leadership position helpful	0	2			
q39 Were you made aware of and apply for scholarship opportunities	2	0	1.50	1.50	.707

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q40a Study Abroad	2	0	2.00	2.00	.000
q40b Internship Abroad	2	0	2.00	2.00	.000
q40c I did participate in the Internship Abroad program	2	0	2.00	2.00	.000
q41_1 Limited: Funding	2	0	.00	.00	.000
q41_2 Limited: Time	2	0	.00	.00	.000
q41_3 Limited: Personal obligations	2	0	.00	.00	.000
q41_4 Limited: Military obligations	2	0	.00	.00	.000
q41_5 Limited: Lack of FSU "Gen-Ed" credit/recognition	2	0	.00	.00	.000
q41_6 Limited: Professional obligations	2	0	.00	.00	.000
q41_7 Limited: Not interested	2	0	1.00	1.00	.000
q42 Currently or upon graduation, I plan to or have	2	0	6.00	6.00	7.071
q42a Other specified	2	0			
q43_1 Tools: FSU's Career Placement Services	2	0	.00	.00	.000
q43_2 Tools: Ferris Job Fairs	2	0	1.00	1.00	.000
q43_3 Tools: Internship	2	0	.00	.00	.000
q43_4 Tools: Word-of-mouth	2	0	.50	.50	.707
q43_5 Tools: Newspaper	2	0	.50	.50	.707
q43_6 Tools: On-line	2	0	.50	.50	.707
q43_7 Tools: Not actively seeking employment	2	0	.50	.50	.707
q43_8 Tools: Other	2	0	.00	.00	.000
q43a Other specified	2	0			
q44 How did you hear of Career Placement Services	2	0	1.00	1.00	.000
q44a Other specified	2	0			
q45 My starting salary (without benefits) after graduation	0	2			
q46_1 Flexible: rural areas	2	0	.50	.50	.707
q46_2 Flexible: metropolitan areas	2	0	.00	.00	.000
q46_3 Flexible: outside West Michigan	2	0	.00	.00	.000
q46_4 Flexible: outside Michigan	2	0	.00	.00	.000
q46_5 Flexible: outside the Midwest area	2	0	.00	.00	.000
q46_6 Flexible: Internationally	2	0	.00	.00	.000
q46_7 Flexible: anywhere	2	0	.50	.50	.707
q47 Believe your technical education at FSU has adequately prepared you	2	0	1.00	1.00	.000
q48 In what area(s) was your technical education lacking	2	0			
q49 Best describes your new position	0	2			

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q49a Other specified	2	0			
q50 Type of industry your employer/business serves	0	2			
q50a Other specified	2	0			
q51a Computer networking/Communications	2	0	2.50	2.50	.707
q51b Computer programming/Control	2	0	3.00	3.00	.000
q51c Database	2	0	3.00	3.00	.000
q51d Office/Technical computer application software	2	0	3.00	3.00	.000
q51e Business knowledge	2	0	3.00	3.00	.000
q51f Hands-on skills	2	0	3.00	3.00	.000
q51g Leadership	2	0	3.00	3.00	.000
q51h Problem-solving	2	0	3.00	3.00	.000
q51i Teamwork skills	2	0	3.00	3.00	.000
q51j Technical knowledge	2	0	3.00	3.00	.000
q51k Interpersonal communication	2	0	3.00	3.00	.000
q51l Public speaking communication	2	0	3.00	3.00	.000
q51m Written communication	2	0	3.00	3.00	.000
q51n Management skills	2	0	3.00	3.00	.000
q51o Marketing & Sales	2	0	3.00	3.00	.000
q51p Mathematics	2	0	3.00	3.00	.000
q51q Physics/Chemistry/Science	2	0	3.00	3.00	.000
q51r Quality Assurance/Control	2	0	3.00	3.00	.000
q52 Additional comments	2	0			
q53 Name	2	0			
q54 Home address	2	0			
q55 Home phone	2	0			
q56 E-mail address	2	0			

Frequency Table

q15 I entered Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Immediately after high school	1	50.0	50.0	50.0
	Transferred from another school/institution with more than 12 credits	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q15a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	100.0	100.0	100.0

q16 Other degrees earned before coming to Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	100.0	100.0	100.0

q17 Last high school/college attended prior to Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	50.0	50.0	50.0
	Muskegon Community College	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q18_1 Learn: HS teacher/Counselor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q18_2 Learn: Voc/Tech school teacher/Counselor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	50.0	50.0	50.0
	Selected	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q18_3 Learn: While attending another program at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q18_4 Learn: From advisor at another college

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q18_5 Learn: From visit by FSU faculty at other college

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q18_6 Learn: General marketing, bill boards, etc.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q18_7 Learn: Site tour of high school students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q18_8 Learn: Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	50.0	50.0	50.0
	Selected	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q18a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	50.0	50.0	50.0
	I'm From Big Rapids and i took the hvac program in High school through the career center	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q19 Which Ferris program did you transfer from

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	100.0	100.0	100.0

q20 Why did you switch programs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	100.0	100.0	100.0

q21_1 Format: On-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q21_2 Format: Main campus (face-to-face)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	2	100.0	100.0	100.0

q21_3 Format: Off-campus (face-to-face)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q21_4 Format: Non-Ferris face-to-face

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q21_5 Format: Non-Ferris on-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q22 Format do you prefer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Face-to-face	2	100.0	100.0	100.0

q23 Why you prefer that format

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I like the one on one interaction	1	50.0	50.0	50.0
	Learn better that way	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q24 When did you first start at Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	09/08	1	50.0	50.0	50.0
	09/09	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q25a Appropriate mastery of the techniques, skills, and tools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25b Good critical thinking, problem solving & decision making skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25c Strong technical understanding of my field

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25d Ability to apply technical theory to practical situations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25e Self-motivation & enthusiasm for my chosen profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25f Oral & writing skills necessary to communicate effectively

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25g Prepared and able to assume responsibility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25h Provided adequate social awareness courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25i Effectively used available resources from my program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25j Worked well with individuals with diverse backgrounds

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q25k Commitment to quality, timeliness, continuous improvement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25l Good ethical values

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q25m Challenged intellectually by my courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25n Motivated to a higher level of performance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	100.0	100.0
Missing	System	1	50.0		
Total		2	100.0		

q25o Design and conduct experiments, as well as to analyze and interpret data

		Frequency	Percent
Missing	System	2	100.0

q25p Design a system, component, or process to meet desired needs within realistic constraints

		Frequency	Percent
Missing	System	2	100.0

q25q Broad education necessary to understand the impact of technical/engineering solutions

		Frequency	Percent
Missing	System	2	100.0

q25r Function effectively on (multidisciplinary) teams

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	100.0	100.0
Missing	System	1	50.0		
Total		2	100.0		

q25s Identify, formulate, analyze and solve technical or engineering problems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25t Recognized the need for life-long learning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25u Understand professional, ethical and social responsibilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25v Apply current knowledge and adapt to emerging applications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25w Conduct, analyze and interpret experiments, and apply experimental results

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25x Apply creativity in the design of systems, components, or processes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25y Respect for diversity and knowledge of contemporary professional, societal and global issues

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25z Provided a good mix of courses for my career options

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q25aa Provided adequate technical content courses by my program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q26a Overall mastery of subject matter

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q26b Adequate instruction in the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q26c Involved in my education process inside the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q26d Involved in my education process outside the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q26e Accessible for advising

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q26f Helpful in advising

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q27a Curriculum is current for my industry/profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q27b Overall quality of the labs & hands-on components were relevant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	1	50.0	100.0	100.0
Missing	System	1	50.0		
Total		2	100.0		

q27c Rate the quality of my curriculum as good

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q28 Required an internship experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	2	100.0	100.0	100.0

q29 The internship experience was an important aspect

		Frequency	Percent
Missing	System	2	100.0

q30a Classrooms provide a good learning environment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q30b Equipment & supplies were available and maintained

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q30c Lab equipment was representative

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q30d Instructional lab facilities were in good condition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	50.0	50.0
	Strongly Agree	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q31a Experiences other than coursework were valuable part of my education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q31b Guest speakers were a valuable part of my education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q31c Adequate learning resources were available

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q31d My overall campus experience was satisfying

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q31e I would recommend my program to others

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q31f I would be interested in working to advance my program at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	100.0	100.0	100.0

q31g Overall, I am very satisfied with my education at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	50.0	100.0	100.0
Missing	System	1	50.0		
Total		2	100.0		

q32 Overall campus experience was satisfying (why/why not)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	50.0	50.0	50.0
	I liked the small class sized and the fact that our teachers know us on a personal level.	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q33 Recommend your program to others (why/why not)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	50.0	50.0	50.0
	I would recommend others to the program because it is very well rounded and provided students with the skills they need for the real world.	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q34 I was a student member of at least one industry/professional organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	50.0	50.0	50.0
	No	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q35 Do you believe your membership helpful

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	50.0	100.0	100.0
Missing	System	1	50.0		
Total		2	100.0		

q36 I participated in other campus/community organizations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	50.0	50.0	50.0
	No	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q37 I served in a leadership position for a student or industry/professional organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	50.0	100.0	100.0
Missing	System	1	50.0		
Total		2	100.0		

q38 Do you believe your leadership position helpful

		Frequency	Percent
Missing	System	2	100.0

q39 Were you made aware of and apply for scholarship opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	50.0	50.0	50.0
	No	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q40a Study Abroad

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	2	100.0	100.0	100.0

q40b Internship Abroad

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	2	100.0	100.0	100.0

q40c I did participate in the Internship Abroad program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	2	100.0	100.0	100.0

q41_1 Limited: Funding

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q41_2 Limited: Time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q41_3 Limited: Personal obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q41_4 Limited: Military obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q41_5 Limited: Lack of FSU "Gen-Ed" credit/recognition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q41_6 Limited: Professional obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q41_7 Limited: Not interested

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	2	100.0	100.0	100.0

q42 Currently or upon graduation, I plan to or have

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Seek employment	1	50.0	50.0	50.0
	Other	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q42a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	50.0	50.0	50.0
	Continuing on to the 4 year	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q43_1 Tools: FSU's Career Placement Services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q43_2 Tools: Ferris Job Fairs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	2	100.0	100.0	100.0

q43_3 Tools: Internship

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q43_4 Tools: Word-of-mouth

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	50.0	50.0	50.0
	Selected	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q43_5 Tools: Newspaper

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	50.0	50.0	50.0
	Selected	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q43_6 Tools: On-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	50.0	50.0	50.0
	Selected	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q43_7 Tools: Not actively seeking employment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	50.0	50.0	50.0
	Selected	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q43_8 Tools: Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q43a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	100.0	100.0	100.0

q44 How did you hear of Career Placement Services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ferris Job Fairs	2	100.0	100.0	100.0

q44a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	100.0	100.0	100.0

q45 My starting salary (without benefits) after graduation

		Frequency	Percent
Missing	System	2	100.0

q46_1 Flexible: rural areas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	50.0	50.0	50.0
	Selected	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q46_2 Flexible: metropolitan areas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q46_3 Flexible: outside West Michigan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q46_4 Flexible: outside Michigan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q46_5 Flexible: outside the Midwest area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q46_6 Flexible: Internationally

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	100.0	100.0	100.0

q46_7 Flexible: anywhere

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	50.0	50.0	50.0
	Selected	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q47 Believe your technical education at FSU has adequately prepared you

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	2	100.0	100.0	100.0

q48 In what area(s) was your technical education lacking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	50.0	50.0	50.0
	Maybe more equipment that we will see on the job	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q49 Best describes your new position

		Frequency	Percent
Missing	System	2	100.0

q49a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	100.0	100.0	100.0

q50 Type of industry your employer/business serves

		Frequency	Percent
Missing	System	2	100.0

q50a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	100.0	100.0	100.0

q51a Computer networking/Communications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	50.0	50.0	50.0
	Very Important	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q51b Computer programming/Control

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51c Database

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51d Office/Technical computer application software

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51e Business knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51f Hands-on skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51g Leadership

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51h Problem-solving

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51i Teamwork skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51j Technical knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51k Interpersonal communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51l Public speaking communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51m Written communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51n Management skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51o Marketing & Sales

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51p Mathematics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51q Physics/Chemistry/Science

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q51r Quality Assurance/Control

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	100.0	100.0	100.0

q52 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	100.0	100.0	100.0

q53 Name

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Andrew Malcomnson	1	50.0	50.0	50.0
	Nicholas Rabach	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q54 Home address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	23259 11 mile road	1	50.0	50.0	50.0
	4493 S.Virginia Dr., Muskegon, MI 49444	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q55 Home phone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	231 750 1705	1	50.0	50.0	50.0
	2315801405	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

q56 E-mail address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	amalcomnson@gmail.com	1	50.0	50.0	50.0
	rabachn@ferris.edu	1	50.0	50.0	100.0
	Total	2	100.0	100.0	

11Sp Grad Exit...BS HVACR Engineering

Frequencies

Prepared by: Institutional Research & Testing, 09/11

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q15 I entered Ferris	6	0	2.00	2.00	.632
q15a Other specified	6	0			
q16 Other degrees earned before coming to Ferris	6	0			
q17 Last high school/college attended prior to Ferris	6	0			
q18_1 Learn: HS teacher/Counselor	5	1	.20	.00	.447
q18_2 Learn: Voc/Tech school teacher/Counselor	5	1	.40	.00	.548
q18_3 Learn: While attending another program at FSU	5	1	.00	.00	.000
q18_4 Learn: From advisor at another college	5	1	.20	.00	.447
q18_5 Learn: From visit by FSU faculty at other college	5	1	.40	.00	.548
q18_6 Learn: General marketing, bill boards, etc.	5	1	.00	.00	.000
q18_7 Learn: Site tour of high school students	5	1	.20	.00	.447
q18_8 Learn: Other	5	1	.20	.00	.447
q18a Other specified	6	0			
q19 Which Ferris program did you transfer from	6	0			
q20 Why did you switch programs	6	0			
q21_1 Format: On-line	5	1	.00	.00	.000
q21_2 Format: Main campus (face-to-face)	5	1	.80	1.00	.447
q21_3 Format: Off-campus (face-to-face)	5	1	.20	.00	.447
q21_4 Format: Non-Ferris face-to-face	5	1	.00	.00	.000
q21_5 Format: Non-Ferris on-line	5	1	.00	.00	.000
q22 Format do you prefer	5	1	1.00	1.00	.000
q23 Please explain why you prefer that format	6	0			
q24 When did you first start at Ferris	6	0			
q25a Appropriate mastery of the techniques, skills, and tools	5	1	4.20	4.00	.447
q25b Good critical thinking, problem solving & decision making skills	5	1	4.40	4.00	.548
q25c Strong technical understanding of my field	5	1	4.00	4.00	.000
q25d Ability to apply technical theory to practical situations	5	1	4.20	4.00	.447
q25e Self-motivation & enthusiasm for my chosen profession	5	1	4.40	4.00	.548
q25f Oral & writing skills necessary to communicate effectively	5	1	4.40	4.00	.548

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q25g Prepared and able to assume responsibility	5	1	4.20	4.00	.447
q25h Provided adequate social awareness courses	5	1	4.20	4.00	.447
q25aa Effectively used available resources from my program	5	1	4.20	4.00	.447
q25i Worked well with individuals with diverse backgrounds	5	1	4.20	4.00	.447
q25j Commitment to quality, timeliness, continuous improvement	5	1	4.20	4.00	.447
q25k Good ethical values	5	1	4.40	4.00	.548
q25l Challenged intellectually by my courses	4	2	4.25	4.00	.500
q25m Motivated to a higher level of performance	5	1	4.00	4.00	.707
q25n Design and conduct experiments, as well as to analyze and interpret data	0	6			
q25o Design a system, component, or process to meet desired needs within realistic constraints	0	6			
q25p Broad education necessary to understand the impact of technical/engineering solutions	0	6			
q25q Function effectively on (multidisciplinary) teams	5	1	4.00	4.00	.707
q25r Identify, formulate, analyze and solve technical or engineering problems	5	1	4.40	4.00	.548
q25s Recognized the need for life-long learning	5	1	4.20	4.00	.447
q25t Understand professional, ethical and social responsibilities	5	1	4.20	4.00	.447
q25u Apply current knowledge and adapt to emerging applications	5	1	4.20	4.00	.447
q25v Conduct, analyze and interpret experiments, and apply experimental results	5	1	4.20	4.00	.447
q25w Apply creativity in the design of systems, components, or processes	5	1	4.00	4.00	.707
q25x Respect for diversity and knowledge of contemporary professional, societal and global issues	5	1	4.20	4.00	.447
q25y Provided by my program a good mix of courses for my career options	5	1	4.20	4.00	.447
q25z Provided adequate technical content courses by my program	5	1	4.20	4.00	.447
q26a Overall mastery of subject matter	5	1	3.20	3.00	.837
q26b Adequate instruction in the classroom	5	1	2.80	3.00	.447
q26c Involved in my education process inside the classroom	5	1	3.40	3.00	.548

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q26d Involved in my education process outside the classroom	5	1	3.00	3.00	.707
q26e Accessible for advising	5	1	3.00	3.00	.000
q26f Helpful in advising	5	1	3.20	3.00	.447
q27a Curriculum is current for my industry/profession	5	1	3.20	3.00	.447
q27b Overall quality of the labs & hands-on components were relevant	5	1	3.00	3.00	.707
q27c Rate the quality of my curriculum as good	5	1	3.40	3.00	.548
q28 Required an internship experience	3	3	1.00	1.00	.000
q29 The internship experience was an important aspect	3	3	1.00	1.00	.000
q30a Classrooms provide a good learning environment	5	1	3.20	3.00	.447
q30b Equipment & supplies were available and maintained	5	1	2.80	3.00	.837
q30c Lab equipment was representative	4	2	3.00	3.00	.816
q30d Instructional lab facilities were in good condition	5	1	3.20	3.00	.447
q31a Experiences other than coursework were valuable part of my education	5	1	3.20	3.00	.447
q31b Guest speakers were a valuable part of my education	5	1	3.20	3.00	.447
q31c Adequate learning resources were available	5	1	3.00	3.00	.707
q31d My overall campus experience was satisfying	5	1	3.00	3.00	.707
q31e I would recommend my program to others	5	1	3.40	3.00	.548
q31f I would be interested in working to advance my program at FSU	5	1	2.80	3.00	.447
q31g Overall, I am very satisfied with my education at FSU	5	1	3.40	3.00	.548
q32 Overall campus experience was satisfying (why/why not)	6	0			
q33 Recommend your program to others (why/why not)	6	0			
q34 I was a student member of at least one industry/professional organization	5	1	1.20	1.00	.447
q35 Do you believe your membership helpful	4	2	1.75	2.00	.500
q36 I participated in other campus/community organizations	5	1	2.00	2.00	.707
q37 I served in a leadership position for a student or industry/professional organization	2	4	2.00	2.00	1.414
q38 Do you believe your leadership position helpful	1	5	2.00	2.00	

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q39 Were you made aware of and apply for scholarship opportunities	5	1	1.20	1.00	.447
q40a Study Abroad	5	1	1.80	2.00	.447
q40b Internship Abroad	5	1	1.60	2.00	.548
q40c I did participate in the Internship Abroad program	5	1	2.00	2.00	.000
q41_1 Limited: Funding	5	1	.60	1.00	.548
q41_2 Limited: Time	5	1	.40	.00	.548
q41_3 Limited: Personal obligations	5	1	.80	1.00	.447
q41_4 Limited: Military obligations	5	1	.00	.00	.000
q41_5 Limited: Lack of FSU "Gen-Ed" credit/recognition	5	1	.00	.00	.000
q41_6 Limited: Professional obligations	5	1	.00	.00	.000
q41_7 Limited: Not interested	5	1	.80	1.00	.447
q42 Currently or upon graduation, I plan to or have	5	1	4.60	6.00	2.191
q42a Other specified	6	0			
q43_1 Tools: FSU's Career Placement Services	5	1	.20	.00	.447
q43_2 Tools: Ferris Job Fairs	5	1	1.00	1.00	.000
q43_3 Tools: Internship	5	1	.60	1.00	.548
q43_4 Tools: Word-of-mouth	5	1	.60	1.00	.548
q43_5 Tools: Newspaper	5	1	.20	.00	.447
q43_6 Tools: On-line	5	1	.80	1.00	.447
q43_7 Tools: Not actively seeking employment	5	1	.00	.00	.000
q43_8 Tools: Other	5	1	.40	.00	.548
q43a Other specified	6	0			
q44 How did you hear of Career Placement Services	4	2	1.75	2.00	.500
q44a Other specified	6	0			
q45 My starting salary (without benefits) after graduation	3	3	6.00	6.00	2.000
q46_1 Flexible: rural areas	5	1	.60	1.00	.548
q46_2 Flexible: metropolitan areas	5	1	.40	.00	.548
q46_3 Flexible: outside West Michigan	5	1	.60	1.00	.548
q46_4 Flexible: outside Michigan	5	1	.60	1.00	.548
q46_5 Flexible: outside the Midwest area	5	1	.20	.00	.447
q46_6 Flexible: Internationally	5	1	.00	.00	.000
q46_7 Flexible: anywhere	5	1	.40	.00	.548
q47 Believe your technical education at FSU has adequately prepared you	5	1	1.00	1.00	.000
q48 In what area(s) was your technical education lacking	6	0			

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q49 Best describes your new position	3	3	23.33	26.00	4.619
q49a Other specified	6	0			
q50 Type of industry your employer/business serves	3	3	13.00	13.00	.000
q50a Other specified	6	0			
q51a Computer networking/Communications	5	1	3.20	3.00	.837
q51b Computer programming/Control	5	1	3.20	3.00	.837
q51c Database	5	1	2.80	3.00	.447
q51d Office/Technical computer application software	5	1	3.40	3.00	.548
q51e Business knowledge	5	1	3.00	3.00	.000
q51f Hands-on skills	5	1	3.00	3.00	.707
q51g Leadership	5	1	3.00	3.00	.707
q51h Problem-solving	5	1	3.40	3.00	.548
q51i Teamwork skills	5	1	3.40	3.00	.548
q51j Technical knowledge	5	1	3.20	3.00	.447
q51k Interpersonal communication	5	1	3.40	3.00	.548
q51l Public speaking communication	5	1	2.60	3.00	.548
q51m Written communication	5	1	2.80	3.00	.447
q51n Management skills	5	1	3.00	3.00	.707
q51o Marketing & Sales	5	1	2.40	2.00	.548
q51p Mathematics	5	1	2.40	2.00	.548
q51q Physics/Chemistry/Science	5	1	2.40	2.00	.548
q51r Quality Assurance/Control	5	1	2.60	3.00	.548
q52 Additional comments	6	0			

Frequency Table

q15 I entered Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Immediately after high school	1	16.7	16.7	16.7
	With an Associate's degree	4	66.7	66.7	83.3
	Transferred from another school/institution with more than 12 credits	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q15a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

q16 Other degrees earned before coming to Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	33.3	33.3	33.3
	AAS HVAC Technology	1	16.7	16.7	50.0
	Air Conditioning, Refrigeration and Heating Technology	2	33.3	33.3	83.3
	associate of applied science refrigeration	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q17 Last high school/college attended prior to Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	16.7	16.7	16.7
	Big Rapids High School	1	16.7	16.7	33.3
	Grand Rapids Community College	2	33.3	33.3	66.7
	Mid Michigan Community College	1	16.7	16.7	83.3
	wayne county community college	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q18_1 Learn: HS teacher/Counselor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	80.0	80.0
	Selected	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q18_2 Learn: Voc/Tech school teacher/Counselor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	3	50.0	60.0	60.0
	Selected	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q18_3 Learn: While attending another program at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q18_4 Learn: From advisor at another college

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	80.0	80.0
	Selected	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q18_5 Learn: From visit by FSU faculty at other college

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	3	50.0	60.0	60.0
	Selected	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q18_6 Learn: General marketing, bill boards, etc.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q18_7 Learn: Site tour of high school students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	80.0	80.0
	Selected	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q18_8 Learn: Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	80.0	80.0
	Selected	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q18a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	83.3	83.3	83.3
	From a friend enrolling in the program.	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q19 Which Ferris program did you transfer from

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

q20 Why did you switch programs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

q21_1 Format: On-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q21_2 Format: Main campus (face-to-face)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	16.7	20.0	20.0
	Selected	4	66.7	80.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q21_3 Format: Off-campus (face-to-face)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	80.0	80.0
	Selected	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q21_4 Format: Non-Ferris face-to-face

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q21_5 Format: Non-Ferris on-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q22 Format do you prefer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Face-to-face	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q23 Please explain why you prefer that format

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	33.3	33.3	33.3
	Easier to learn and comprehend was is being discussed.	1	16.7	16.7	50.0
	I like to be able to ask a question and have it resolved immediately, and the hands on in class is a better format for myself.	1	16.7	16.7	66.7
	I really learn better in a classroom atmosphere and like to have personal interaction as supposed to communicating electronically through e-mail or posts.	1	16.7	16.7	83.3
	Instructors are more accessible for aid.	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q24 When did you first start at Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	33.3	33.3	33.3
	08/07	1	16.7	16.7	50.0
	08/09	2	33.3	33.3	83.3
	09/2009	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q25a Appropriate mastery of the techniques, skills, and tools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25b Good critical thinking, problem solving & decision making skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	60.0	60.0
	Strongly Agree	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25c Strong technical understanding of my field

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q25d Ability to apply technical theory to practical situations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25e Self-motivation & enthusiasm for my chosen profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	60.0	60.0
	Strongly Agree	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25f Oral & writing skills necessary to communicate effectively

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	60.0	60.0
	Strongly Agree	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25g Prepared and able to assume responsibility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25h Provided adequate social awareness courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25aa Effectively used available resources from my program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25i Worked well with individuals with diverse backgrounds

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25j Commitment to quality, timeliness, continuous improvement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25k Good ethical values

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	60.0	60.0
	Strongly Agree	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25l Challenged intellectually by my courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	75.0	75.0
	Strongly Agree	1	16.7	25.0	100.0
	Total	4	66.7	100.0	
Missing	System	2	33.3		
Total		6	100.0		

q25m Motivated to a higher level of performance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	16.7	20.0	20.0
	Somewhat Agree	3	50.0	60.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25n Design and conduct experiments, as well as to analyze and interpret data

		Frequency	Percent
Missing	System	6	100.0

q25o Design a system, component, or process to meet desired needs within realistic constraints

		Frequency	Percent
Missing	System	6	100.0

q25p Broad education necessary to understand the impact of technical/engineering solutions

		Frequency	Percent
Missing	System	6	100.0

q25q Function effectively on (multidisciplinary) teams

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	16.7	20.0	20.0
	Somewhat Agree	3	50.0	60.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25r Identify, formulate, analyze and solve technical or engineering problems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	60.0	60.0
	Strongly Agree	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25s Recognized the need for life-long learning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25t Understand professional, ethical and social responsibilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25u Apply current knowledge and adapt to emerging applications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25v Conduct, analyze and interpret experiments, and apply experimental results

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25w Apply creativity in the design of systems, components, or processes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	16.7	20.0	20.0
	Somewhat Agree	3	50.0	60.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25x Respect for diversity and knowledge of contemporary professional, societal and global issues

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25y Provided by my program a good mix of courses for my career options

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q25z Provided adequate technical content courses by my program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q26a Overall mastery of subject matter

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	16.7	20.0	20.0
	Somewhat Agree	2	33.3	40.0	60.0
	Strongly Agree	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q26b Adequate instruction in the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	16.7	20.0	20.0
	Somewhat Agree	4	66.7	80.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q26c Involved in my education process inside the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	60.0	60.0
	Strongly Agree	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q26d Involved in my education process outside the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	16.7	20.0	20.0
	Somewhat Agree	3	50.0	60.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q26e Accessible for advising

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q26f Helpful in advising

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q27a Curriculum is current for my industry/profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q27b Overall quality of the labs & hands-on components were relevant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	16.7	20.0	20.0
	Somewhat Agree	3	50.0	60.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q27c Rate the quality of my curriculum as good

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	60.0	60.0
	Strongly Agree	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q28 Required an internship experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	3	50.0	100.0	100.0
Missing	System	3	50.0		
Total		6	100.0		

q29 The internship experience was an important aspect

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	3	50.0	100.0	100.0
Missing	System	3	50.0		
Total		6	100.0		

q30a Classrooms provide a good learning environment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q30b Equipment & supplies were available and maintained

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	2	33.3	40.0	40.0
	Somewhat Agree	2	33.3	40.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q30c Lab equipment was representative

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	16.7	25.0	25.0
	Somewhat Agree	2	33.3	50.0	75.0
	Strongly Agree	1	16.7	25.0	100.0
	Total	4	66.7	100.0	
Missing	System	2	33.3		
Total		6	100.0		

q30d Instructional lab facilities were in good condition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q31a Experiences other than coursework were valuable part of my education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q31b Guest speakers were a valuable part of my education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	66.7	80.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q31c Adequate learning resources were available

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	16.7	20.0	20.0
	Somewhat Agree	3	50.0	60.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q31d My overall campus experience was satisfying

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	16.7	20.0	20.0
	Somewhat Agree	3	50.0	60.0	80.0
	Strongly Agree	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q31e I would recommend my program to others

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	60.0	60.0
	Strongly Agree	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q31f I would be interested in working to advance my program at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	16.7	20.0	20.0
	Somewhat Agree	4	66.7	80.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q31g Overall, I am very satisfied with my education at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	60.0	60.0
	Strongly Agree	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q32 Overall campus experience was satisfying (why/why not)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	66.7	66.7	66.7
	Faculty and staff were very helpful in the cultivating of my degree.	1	16.7	16.7	83.3
	I was an Off Campus Student	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q33 Recommend your program to others (why/why not)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	66.7	66.7	66.7
	I would recommend the program to others because I value some of the professors who taught me the curriculum.	1	16.7	16.7	83.3
	The program has projected me to a new rewarding career and many attributed to apply to the HVAC/R industry.	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q34 I was a student member of at least one industry/professional organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	4	66.7	80.0	80.0
	No	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q35 Do you believe your membership helpful

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	16.7	25.0	25.0
	No	3	50.0	75.0	100.0
	Total	4	66.7	100.0	
Missing	System	2	33.3		
Total		6	100.0		

q36 I participated in other campus/community organizations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	16.7	20.0	20.0
	No	3	50.0	60.0	80.0
	Not aware of other opportunities	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q37 I served in a leadership position for a student or industry/professional organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	16.7	50.0	50.0
	Not applicable	1	16.7	50.0	100.0
	Total	2	33.3	100.0	
Missing	System	4	66.7		
Total		6	100.0		

q38 Do you believe your leadership position helpful

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	16.7	100.0	100.0
Missing	System	5	83.3		
Total		6	100.0		

q39 Were you made aware of and apply for scholarship opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	4	66.7	80.0	80.0
	No	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q40a Study Abroad

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	16.7	20.0	20.0
	No	4	66.7	80.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q40b Internship Abroad

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	2	33.3	40.0	40.0
	No	3	50.0	60.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q40c I did participate in the Internship Abroad program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q41_1 Limited: Funding

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	33.3	40.0	40.0
	Selected	3	50.0	60.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q41_2 Limited: Time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	3	50.0	60.0	60.0
	Selected	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q41_3 Limited: Personal obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	16.7	20.0	20.0
	Selected	4	66.7	80.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q41_4 Limited: Military obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q41_5 Limited: Lack of FSU "Gen-Ed" credit/recognition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q41_6 Limited: Professional obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q41_7 Limited: Not interested

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	16.7	20.0	20.0
	Selected	4	66.7	80.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q42 Currently or upon graduation, I plan to or have

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Seek employment	1	16.7	20.0	20.0
	Received 2-4 job offers	1	16.7	20.0	40.0
	Accepted a position within my major	3	50.0	60.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q42a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

q43_1 Tools: FSU's Career Placement Services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	80.0	80.0
	Selected	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q43_2 Tools: Ferris Job Fairs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Selected	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q43_3 Tools: Internship

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	33.3	40.0	40.0
	Selected	3	50.0	60.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q43_4 Tools: Word-of-mouth

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	33.3	40.0	40.0
	Selected	3	50.0	60.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q43_5 Tools: Newspaper

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	80.0	80.0
	Selected	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q43_6 Tools: On-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	16.7	20.0	20.0
	Selected	4	66.7	80.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q43_7 Tools: Not actively seeking employment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q43_8 Tools: Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	3	50.0	60.0	60.0
	Selected	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q43a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	66.7	66.7	66.7
	Campus visits by employers	1	16.7	16.7	83.3
	Professors put quite a bit of effort into getting us potential job leads and interviews.	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q44 How did you hear of Career Placement Services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ferris Job Fairs	1	16.7	25.0	25.0
	Word of mouth	3	50.0	75.0	100.0
	Total	4	66.7	100.0	
Missing	System	2	33.3		
Total		6	100.0		

q44a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

q45 My starting salary (without benefits) after graduation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	$40,000-$44,999	1	16.7	33.3	33.3
	$50,000-$54,999	1	16.7	33.3	66.7
	$60,000-$64,999	1	16.7	33.3	100.0
	Total	3	50.0	100.0	
Missing	System	3	50.0		
Total		6	100.0		

q46_1 Flexible: rural areas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	33.3	40.0	40.0
	Selected	3	50.0	60.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q46_2 Flexible: metropolitan areas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	3	50.0	60.0	60.0
	Selected	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q46_3 Flexible: outside West Michigan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	33.3	40.0	40.0
	Selected	3	50.0	60.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q46_4 Flexible: outside Michigan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	33.3	40.0	40.0
	Selected	3	50.0	60.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q46_5 Flexible: outside the Midwest area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	80.0	80.0
	Selected	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q46_6 Flexible: Internationally

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q46_7 Flexible: anywhere

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	3	50.0	60.0	60.0
	Selected	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q47 Believe your technical education at FSU has adequately prepared you

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q48 In what area(s) was your technical education lacking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		3	50.0	50.0	50.0
	Could always be more in depth in certain aspects but time restraints would not allow. Such as more classes in controls and design.	1	16.7	16.7	66.7
	more hands on	1	16.7	16.7	83.3
	Project Management.	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q49 Best describes your new position

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	HVACR	1	16.7	33.3	33.3
	Other	2	33.3	66.7	100.0
	Total	3	50.0	100.0	
Missing	System	3	50.0		
Total		6	100.0		

q49a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	66.7	66.7	66.7
	Project Engineer	1	16.7	16.7	83.3
	systems technician	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q50 Type of industry your employer/business serves

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	HVACR	3	50.0	100.0	100.0
Missing	System	3	50.0		
Total		6	100.0		

q50a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

q51a Computer networking/Communications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	16.7	20.0	20.0
	Very Important	2	33.3	40.0	60.0
	Critical	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51b Computer programming/Control

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	16.7	20.0	20.0
	Very Important	2	33.3	40.0	60.0
	Critical	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51c Database

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	16.7	20.0	20.0
	Very Important	4	66.7	80.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51d Office/Technical computer application software

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	3	50.0	60.0	60.0
	Critical	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51e Business knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q51f Hands-on skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	16.7	20.0	20.0
	Very Important	3	50.0	60.0	80.0
	Critical	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51g Leadership

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	16.7	20.0	20.0
	Very Important	3	50.0	60.0	80.0
	Critical	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51h Problem-solving

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	3	50.0	60.0	60.0
	Critical	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51i Teamwork skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	3	50.0	60.0	60.0
	Critical	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51j Technical knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	4	66.7	80.0	80.0
	Critical	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51k Interpersonal communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	3	50.0	60.0	60.0
	Critical	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51l Public speaking communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	2	33.3	40.0	40.0
	Very Important	3	50.0	60.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51m Written communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	16.7	20.0	20.0
	Very Important	4	66.7	80.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51n Management skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	16.7	20.0	20.0
	Very Important	3	50.0	60.0	80.0
	Critical	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51o Marketing & Sales

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	3	50.0	60.0	60.0
	Very Important	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51p Mathematics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	3	50.0	60.0	60.0
	Very Important	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51q Physics/Chemistry/Science

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	3	50.0	60.0	60.0
	Very Important	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q51r Quality Assurance/Control

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	2	33.3	40.0	40.0
	Very Important	3	50.0	60.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q52 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

12Sp CET Grad...BS HVAC

Frequencies

Prepared by: Institutional Research & Testing, 06/12

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q15 I entered Ferris	6	0	2.33	2.50	.816
q15a Other specified	6	0			
q16 Other degrees earned before coming to Ferris	6	0			
q17 Last high school/college attended prior to Ferris	6	0			
q18_1 Learn: HS teacher/Counselor	6	0	.17	.00	.408
q18_2 Learn: Voc/Tech school teacher/Counselor	6	0	.33	.00	.516
q18_3 Learn: While attending another program at FSU	6	0	.00	.00	.000
q18_4 Learn: From advisor at another college	6	0	.33	.00	.516
q18_5 Learn: From visit by FSU faculty at other college	6	0	.17	.00	.408
q18_6 Learn: General marketing, bill boards, etc.	6	0	.00	.00	.000
q18_7 Learn: Site tour of high school students	6	0	.00	.00	.000
q18_8 Learn: Other	6	0	.33	.00	.516
q18a Other specified	6	0			
q19 Which Ferris program did you transfer from	6	0			
q20 Why did you switch programs	6	0			
q21_1 Format: On-line	6	0	.33	.00	.516
q21_2 Format: Main campus (face-to-face)	6	0	.83	1.00	.408
q21_3 Format: Off-campus (face-to-face)	6	0	.00	.00	.000
q21_4 Format: Non-Ferris face-to-face	6	0	.00	.00	.000
q21_5 Format: Non-Ferris on-line	6	0	.00	.00	.000
q22 Format do you prefer	6	0	1.17	1.00	.408
q23 Why you prefer that format	6	0			
q24 When did you first start at Ferris	6	0			
q25a Appropriate mastery of the techniques, skills, and tools	6	0	4.67	5.00	.516
q25b Good critical thinking, problem solving & decision making skills	6	0	4.50	4.50	.548
q25c Strong technical understanding of my field	6	0	4.67	5.00	.516
q25d Ability to apply technical theory to practical situations	6	0	4.67	5.00	.516
q25e Self-motivation & enthusiasm for my chosen profession	6	0	4.67	5.00	.516
q25f Oral & writing skills necessary to communicate effectively	6	0	4.83	5.00	.408
q25g Prepared and able to assume responsibility	6	0	4.83	5.00	.408

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q25h Provided adequate social awareness courses	6	0	4.50	4.50	.548
q25i Effectively used available resources from my program	6	0	4.50	4.50	.548
q25j Worked well with individuals with diverse backgrounds	6	0	4.50	4.50	.548
q25k Commitment to quality, timeliness, continuous improvement	6	0	4.83	5.00	.408
q25l Good ethical values	6	0	4.67	5.00	.516
q25m Challenged intellectually by my courses	6	0	4.83	5.00	.408
q25n Motivated to a higher level of performance	6	0	4.83	5.00	.408
q25o Design and conduct experiments, as well as to analyze and interpret data	0	6			
q25p Design a system, component, or process to meet desired needs within realistic constraints	0	6			
q25q Broad education necessary to understand the impact of technical/engineering solutions	0	6			
q25r Function effectively on (multidisciplinary) teams	6	0	4.67	5.00	.516
q25s Identify, formulate, analyze and solve technical or engineering problems	6	0	4.50	4.50	.548
q25t Recognized the need for life-long learning	6	0	4.83	5.00	.408
q25u Understand professional, ethical and social responsibilities	6	0	4.83	5.00	.408
q25v Apply current knowledge and adapt to emerging applications	6	0	4.50	4.50	.548
q25w Conduct, analyze and interpret experiments, and apply experimental results	6	0	4.33	4.50	.816
q25x Apply creativity in the design of systems, components, or processes	6	0	4.50	4.50	.548
q25y Respect for diversity and knowledge of contemporary professional, societal and global issues	6	0	4.33	4.50	.816
q25z Provided a good mix of courses for my career options	6	0	4.67	5.00	.516
q25aa Provided adequate technical content courses by my program	6	0	4.83	5.00	.408
q26a Overall mastery of subject matter	6	0	4.00	4.00	.000
q26b Adequate instruction in the classroom	6	0	4.00	4.00	.000
q26c Involved in my education process inside the classroom	6	0	4.00	4.00	.000
q26d Involved in my education process outside the classroom	6	0	3.50	3.50	.548

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q26e Accessible for advising	6	0	3.50	4.00	.837
q26f Helpful in advising	6	0	3.50	4.00	.837
q27a Curriculum is current for my industry/profession	6	0	4.00	4.00	.000
q27b Overall quality of the labs & hands-on components were relevant	6	0	4.00	4.00	.000
q27c Rate the quality of my curriculum as good	5	1	4.00	4.00	.000
q28 Required an internship experience	6	0	1.17	1.00	.408
q29 The internship experience was an important aspect	5	1	1.00	1.00	.000
q30a Classrooms provide a good learning environment	6	0	3.83	4.00	.408
q30b Equipment & supplies were available and maintained	6	0	3.83	4.00	.408
q30c Lab equipment was representative	6	0	3.67	4.00	.516
q30d Instructional lab facilities were in good condition	6	0	3.50	3.50	.548
q31a Experiences other than coursework were valuable part of my education	6	0	3.67	4.00	.516
q31b Guest speakers were a valuable part of my education	6	0	2.83	3.00	.983
q31c Adequate learning resources were available	6	0	3.83	4.00	.408
q31d My overall campus experience was satisfying	6	0	4.00	4.00	.000
q31e I would recommend my program to others	6	0	4.00	4.00	.000
q31f I would be interested in working to advance my program at FSU	6	0	3.83	4.00	.408
q31g Overall, I am very satisfied with my education at FSU	6	0	4.00	4.00	.000
q32 Overall campus experience was satisfying (why/why not)	6	0			
q33 Recommend your program to others (why/why not)	6	0			
q34 I was a student member of at least one industry/professional organization	6	0	1.33	1.00	.516
q35 Do you believe your membership helpful	4	2	1.25	1.00	.500
q36 I participated in other campus/community organizations	6	0	1.67	2.00	.516
q37 I served in a leadership position for a student or industry/professional organization	2	4	1.50	1.50	.707
q38 Do you believe your leadership position helpful	1	5	2.00	2.00	
q39 Were you made aware of and apply for scholarship opportunities	6	0	1.67	2.00	.516

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q40a Study Abroad	6	0	1.50	1.50	.548
q40b Internship Abroad	6	0	1.50	1.50	.548
q40c I did participate in the Internship Abroad program	6	0	2.00	2.00	.000
q41_1 Limited: Funding	6	0	.83	1.00	.408
q41_2 Limited: Time	6	0	.83	1.00	.408
q41_3 Limited: Personal obligations	6	0	.33	.00	.516
q41_4 Limited: Military obligations	6	0	.00	.00	.000
q41_5 Limited: Lack of FSU "Gen-Ed" credit/recognition	6	0	.17	.00	.408
q41_6 Limited: Professional obligations	6	0	.50	.50	.548
q41_7 Limited: Not interested	6	0	.17	.00	.408
q42 Currently or upon graduation, I plan to or have	6	0	5.50	6.00	3.391
q42a Other specified	6	0			
q43_1 Tools: FSU's Career Placement Services	6	0	.67	1.00	.516
q43_2 Tools: Ferris Job Fairs	6	0	.83	1.00	.408
q43_3 Tools: Internship	6	0	.50	.50	.548
q43_4 Tools: Word-of-mouth	6	0	.67	1.00	.516
q43_5 Tools: Newspaper	6	0	.17	.00	.408
q43_6 Tools: On-line	6	0	.33	.00	.516
q43_7 Tools: Not actively seeking employment	6	0	.00	.00	.000
q43_8 Tools: Other	6	0	.33	.00	.516
q43a Other specified	6	0			
q44 How did you hear of Career Placement Services	5	1	1.80	2.00	.447
q44a Other specified	6	0			
q45 My starting salary (without benefits) after graduation	3	3	4.67	4.00	2.082
q46_1 Flexible: rural areas	6	0	.67	1.00	.516
q46_2 Flexible: metropolitan areas	6	0	.50	.50	.548
q46_3 Flexible: outside West Michigan	6	0	.50	.50	.548
q46_4 Flexible: outside Michigan	6	0	.50	.50	.548
q46_5 Flexible: outside the Midwest area	6	0	.67	1.00	.516
q46_6 Flexible: Internationally	6	0	.17	.00	.408
q46_7 Flexible: anywhere	6	0	.67	1.00	.516
q47 Believe your technical education at FSU has adequately prepared you	6	0	1.00	1.00	.000
q48 In what area(s) was your technical education lacking	6	0			
q49 Best describes your new position	3	3	19.33	18.00	2.309

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
q49a Other specified	6	0			
q50 Type of industry your employer/business serves	3	3	13.00	13.00	.000
q50a Other specified	6	0			
q51a Computer networking/Communications	6	0	3.00	3.00	1.095
q51b Computer programming/Control	6	0	2.50	3.00	.837
q51c Database	6	0	2.00	2.00	.894
q51d Office/Technical computer application software	6	0	3.00	3.00	.632
q51e Business knowledge	6	0	3.33	3.50	.816
q51f Hands-on skills	6	0	3.33	3.00	.516
q51g Leadership	6	0	3.33	3.50	.816
q51h Problem-solving	6	0	3.67	4.00	.516
q51i Teamwork skills	6	0	3.67	4.00	.516
q51j Technical knowledge	6	0	3.67	4.00	.516
q51k Interpersonal communication	6	0	3.33	3.00	.516
q51l Public speaking communication	6	0	3.33	3.50	.816
q51m Written communication	6	0	3.67	4.00	.516
q51n Management skills	6	0	3.00	3.00	.894
q51o Marketing & Sales	6	0	3.00	3.00	.894
q51p Mathematics	6	0	2.83	3.00	.983
q51q Physics/Chemistry/Science	6	0	2.17	2.00	.983
q51r Quality Assurance/Control	6	0	2.83	2.50	.983
q52 Additional comments	6	0			
q53 Name	6	0			
q54 Home address	6	0			
q55 Home phone	6	0			
q56 E-mail address	6	0			

Frequency Table

q15 I entered Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Immediately after high school	1	16.7	16.7	16.7
	With an Associate's degree	2	33.3	33.3	50.0
	Transferred from another school/institution with more than 12 credits	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q15a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	83.3	83.3	83.3
	A.s.s From Grcc in HVAC	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q16 Other degrees earned before coming to Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	33.3	33.3	33.3
	AAS ACHR Technology	1	16.7	16.7	50.0
	AAS Automotive Service Technology, AAS HVACR Technology	1	16.7	16.7	66.7
	Certificate From KCTC	1	16.7	16.7	83.3
	HVAC Technician; HVAC Technology	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q17 Last high school/college attended prior to Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Clarenceville High School	1	16.7	16.7	16.7
	Grand Rapids Community College	1	16.7	16.7	33.3
	GRCC	1	16.7	16.7	50.0
	Harford Community College	1	16.7	16.7	66.7
	Humber College	1	16.7	16.7	83.3
	Western Technical College	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q18_1 Learn: HS teacher/Counselor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	83.3	83.3
	Selected	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q18_2 Learn: Voc/Tech school teacher/Counselor

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	66.7	66.7
	Selected	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q18_3 Learn: While attending another program at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	6	100.0	100.0	100.0

q18_4 Learn: From advisor at another college

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	66.7	66.7
	Selected	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q18_5 Learn: From visit by FSU faculty at other college

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	83.3	83.3
	Selected	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q18_6 Learn: General marketing, bill boards, etc.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	6	100.0	100.0	100.0

q18_7 Learn: Site tour of high school students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	6	100.0	100.0	100.0

q18_8 Learn: Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	66.7	66.7
	Selected	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q18a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	66.7	66.7	66.7
	Client	1	16.7	16.7	83.3
	Family member	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q19 Which Ferris program did you transfer from

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

q20 Why did you switch programs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

q21_1 Format: On-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	66.7	66.7
	Selected	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q21_2 Format: Main campus (face-to-face)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	16.7	16.7	16.7
	Selected	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q21_3 Format: Off-campus (face-to-face)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	6	100.0	100.0	100.0

q21_4 Format: Non-Ferris face-to-face

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	6	100.0	100.0	100.0

q21_5 Format: Non-Ferris on-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	6	100.0	100.0	100.0

q22 Format do you prefer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Face-to-face	5	83.3	83.3	83.3
	On-line	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q23 Why you prefer that format

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I live in Maryland, and it was flexible with my work schedule.	1	16.7	16.7	16.7
	I personally learn more from being able to ask questions in person and I am more motivated to make sure I am at class and up-to-date on readings, homework assignments, etc...	1	16.7	16.7	33.3
	It's more personal	1	16.7	16.7	50.0
	Its easier to communicate.	1	16.7	16.7	66.7
	the personal touch with other teachers and what not	1	16.7	16.7	83.3
	This format provides immediate feedback to questions or concerns that may arise during coursework.	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q24 When did you first start at Ferris

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	08/06	1	16.7	16.7	16.7
	08/08	1	16.7	16.7	33.3
	08/2010	2	33.3	33.3	66.7
	09/10	1	16.7	16.7	83.3
	10/2009	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q25a Appropriate mastery of the techniques, skills, and tools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	33.3	33.3	33.3
	Strongly Agree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q25b Good critical thinking, problem solving & decision making skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	50.0	50.0
	Strongly Agree	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q25c Strong technical understanding of my field

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	33.3	33.3	33.3
	Strongly Agree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q25d Ability to apply technical theory to practical situations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	33.3	33.3	33.3
	Strongly Agree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q25e Self-motivation & enthusiasm for my chosen profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	33.3	33.3	33.3
	Strongly Agree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q25f Oral & writing skills necessary to communicate effectively

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q25g Prepared and able to assume responsibility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q25h Provided adequate social awareness courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	50.0	50.0
	Strongly Agree	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q25i Effectively used available resources from my program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	50.0	50.0
	Strongly Agree	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q25j Worked well with individuals with diverse backgrounds

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	50.0	50.0
	Strongly Agree	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q25k Commitment to quality, timeliness, continuous improvement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q25l Good ethical values

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	33.3	33.3	33.3
	Strongly Agree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q25m Challenged intellectually by my courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q25n Motivated to a higher level of performance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q25o Design and conduct experiments, as well as to analyze and interpret data

		Frequency	Percent
Missing	System	6	100.0

q25p Design a system, component, or process to meet desired needs within realistic constraints

		Frequency	Percent
Missing	System	6	100.0

q25q Broad education necessary to understand the impact of technical/engineering solutions

		Frequency	Percent
Missing	System	6	100.0

q25r Function effectively on (multidisciplinary) teams

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	33.3	33.3	33.3
	Strongly Agree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q25s Identify, formulate, analyze and solve technical or engineering problems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	50.0	50.0
	Strongly Agree	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q25t Recognized the need for life-long learning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q25u Understand professional, ethical and social responsibilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q25v Apply current knowledge and adapt to emerging applications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	50.0	50.0
	Strongly Agree	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q25w Conduct, analyze and interpret experiments, and apply experimental results

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	16.7	16.7	16.7
	Somewhat Agree	2	33.3	33.3	50.0
	Strongly Agree	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q25x Apply creativity in the design of systems, components, or processes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	50.0	50.0
	Strongly Agree	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q25y Respect for diversity and knowledge of contemporary professional, societal and global issues

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	16.7	16.7	16.7
	Somewhat Agree	2	33.3	33.3	50.0
	Strongly Agree	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q25z Provided a good mix of courses for my career options

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	33.3	33.3	33.3
	Strongly Agree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q25aa Provided adequate technical content courses by my program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q26a Overall mastery of subject matter

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	100.0	100.0	100.0

q26b Adequate instruction in the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	100.0	100.0	100.0

q26c Involved in my education process inside the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	100.0	100.0	100.0

q26d Involved in my education process outside the classroom

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	50.0	50.0
	Strongly Agree	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q26e Accessible for advising

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	16.7	16.7	16.7
	Somewhat Agree	1	16.7	16.7	33.3
	Strongly Agree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q26f Helpful in advising

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	16.7	16.7	16.7
	Somewhat Agree	1	16.7	16.7	33.3
	Strongly Agree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q27a Curriculum is current for my industry/profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	100.0	100.0	100.0

q27b Overall quality of the labs & hands-on components were relevant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	100.0	100.0	100.0

q27c Rate the quality of my curriculum as good

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q28 Required an internship experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	5	83.3	83.3	83.3
	No	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q29 The internship experience was an important aspect

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	5	83.3	100.0	100.0
Missing	System	1	16.7		
Total		6	100.0		

q30a Classrooms provide a good learning environment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q30b Equipment & supplies were available and maintained

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q30c Lab equipment was representative

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	33.3	33.3	33.3
	Strongly Agree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q30d Instructional lab facilities were in good condition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	50.0	50.0	50.0
	Strongly Agree	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q31a Experiences other than coursework were valuable part of my education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	2	33.3	33.3	33.3
	Strongly Agree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q31b Guest speakers were a valuable part of my education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	16.7	16.7	16.7
	Somewhat Agree	4	66.7	66.7	83.3
	Strongly Agree	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q31c Adequate learning resources were available

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q31d My overall campus experience was satisfying

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	100.0	100.0	100.0

q31e I would recommend my program to others

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	100.0	100.0	100.0

q31f I would be interested in working to advance my program at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	1	16.7	16.7	16.7
	Strongly Agree	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q31g Overall, I am very satisfied with my education at FSU

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	100.0	100.0	100.0

q32 Overall campus experience was satisfying (why/why not)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	66.7	66.7	66.7
	Ferris was fun. I made a lot of friends and learnt so much	1	16.7	16.7	83.3
	I feel that I have received the education I planned for.	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q33 Recommend your program to others (why/why not)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		3	50.0	50.0	50.0
	Its a great program that gives you real life experience.	1	16.7	16.7	66.7
	The HVAC/R Engineering Tech program is very good. The field is never dead, and it makes a lot of money	1	16.7	16.7	83.3
	The professors are very knowledgable about their field and are able to relate coursework to real-life experiences.	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q34 I was a student member of at least one industry/professional organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	4	66.7	66.7	66.7
	No	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q35 Do you believe your membership helpful

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	3	50.0	75.0	75.0
	No	1	16.7	25.0	100.0
	Total	4	66.7	100.0	
Missing	System	2	33.3		
Total		6	100.0		

q36 I participated in other campus/community organizations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	2	33.3	33.3	33.3
	No	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q37 I served in a leadership position for a student or industry/professional organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	16.7	50.0	50.0
	No	1	16.7	50.0	100.0
	Total	2	33.3	100.0	
Missing	System	4	66.7		
Total		6	100.0		

q38 Do you believe your leadership position helpful

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1	16.7	100.0	100.0
Missing	System	5	83.3		
Total		6	100.0		

q39 Were you made aware of and apply for scholarship opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	2	33.3	33.3	33.3
	No	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q40a Study Abroad

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	3	50.0	50.0	50.0
	No	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q40b Internship Abroad

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	3	50.0	50.0	50.0
	No	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q40c I did participate in the Internship Abroad program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	6	100.0	100.0	100.0

q41_1 Limited: Funding

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	16.7	16.7	16.7
	Selected	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q41_2 Limited: Time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	16.7	16.7	16.7
	Selected	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q41_3 Limited: Personal obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	66.7	66.7
	Selected	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q41_4 Limited: Military obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	6	100.0	100.0	100.0

q41_5 Limited: Lack of FSU "Gen-Ed" credit/recognition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	83.3	83.3
	Selected	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q41_6 Limited: Professional obligations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	3	50.0	50.0	50.0
	Selected	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q41_7 Limited: Not interested

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	83.3	83.3
	Selected	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q42 Currently or upon graduation, I plan to or have

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Seek employment	1	16.7	16.7	16.7
	Received 1 job offer	1	16.7	16.7	33.3
	Accepted a position within my major	3	50.0	50.0	83.3
	Other	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q42a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	83.3	83.3	83.3
	Currently employed within my major	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q43_1 Tools: FSU's Career Placement Services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	33.3	33.3	33.3
	Selected	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q43_2 Tools: Ferris Job Fairs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	1	16.7	16.7	16.7
	Selected	5	83.3	83.3	100.0
	Total	6	100.0	100.0	

q43_3 Tools: Internship

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	3	50.0	50.0	50.0
	Selected	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q43_4 Tools: Word-of-mouth

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	33.3	33.3	33.3
	Selected	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q43_5 Tools: Newspaper

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	83.3	83.3
	Selected	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q43_6 Tools: On-line

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	66.7	66.7
	Selected	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q43_7 Tools: Not actively seeking employment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	6	100.0	100.0	100.0

q43_8 Tools: Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	4	66.7	66.7	66.7
	Selected	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q43a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	83.3	83.3	83.3
	Career opportunities that were sent to my professors and then passed on to us students.	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q44 How did you hear of Career Placement Services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ferris Job Fairs	1	16.7	20.0	20.0
	Word of mouth	4	66.7	80.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

q44a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

q45 My starting salary (without benefits) after graduation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	$35,000-$39,999	1	16.7	33.3	33.3
	$40,000-$44,999	1	16.7	33.3	66.7
	$55,000-$59,000	1	16.7	33.3	100.0
	Total	3	50.0	100.0	
Missing	System	3	50.0		
Total		6	100.0		

q46_1 Flexible: rural areas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	33.3	33.3	33.3
	Selected	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q46_2 Flexible: metropolitan areas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	3	50.0	50.0	50.0
	Selected	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q46_3 Flexible: outside West Michigan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	3	50.0	50.0	50.0
	Selected	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q46_4 Flexible: outside Michigan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	3	50.0	50.0	50.0
	Selected	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q46_5 Flexible: outside the Midwest area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	33.3	33.3	33.3
	Selected	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q46_6 Flexible: Internationally

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	5	83.3	83.3	83.3
	Selected	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q46_7 Flexible: anywhere

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Selected	2	33.3	33.3	33.3
	Selected	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q47 Believe your technical education at FSU has adequately prepared you

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	6	100.0	100.0	100.0

q48 In what area(s) was your technical education lacking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		3	50.0	50.0	50.0
	Controls	1	16.7	16.7	66.7
	I would have liked to have seen more on energy modeling and calculations.	1	16.7	16.7	83.3
	Technical writing	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q49 Best describes your new position

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	HVACR	2	33.3	66.7	66.7
	Sales/Marketing	1	16.7	33.3	100.0
	Total	3	50.0	100.0	
Missing	System	3	50.0		
Total		6	100.0		

q49a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

q50 Type of industry your employer/business serves

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	HVACR	3	50.0	100.0	100.0
Missing	System	3	50.0		
Total		6	100.0		

q50a Other specified

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	100.0	100.0	100.0

q51a Computer networking/Communications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Important	1	16.7	16.7	16.7
	Very Important	3	50.0	50.0	66.7
	Critical	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q51b Computer programming/Control

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Important	1	16.7	16.7	16.7
	Somewhat Important	1	16.7	16.7	33.3
	Very Important	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q51c Database

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Important	2	33.3	33.3	33.3
	Somewhat Important	2	33.3	33.3	66.7
	Very Important	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q51d Office/Technical computer application software

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	16.7	16.7	16.7
	Very Important	4	66.7	66.7	83.3
	Critical	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q51e Business knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	16.7	16.7	16.7
	Very Important	2	33.3	33.3	50.0
	Critical	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q51f Hands-on skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	4	66.7	66.7	66.7
	Critical	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q51g Leadership

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	16.7	16.7	16.7
	Very Important	2	33.3	33.3	50.0
	Critical	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q51h Problem-solving

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	33.3	33.3	33.3
	Critical	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q51i Teamwork skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	33.3	33.3	33.3
	Critical	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q51j Technical knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	33.3	33.3	33.3
	Critical	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q51k Interpersonal communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	4	66.7	66.7	66.7
	Critical	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q51l Public speaking communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	1	16.7	16.7	16.7
	Very Important	2	33.3	33.3	50.0
	Critical	3	50.0	50.0	100.0
	Total	6	100.0	100.0	

q51m Written communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	2	33.3	33.3	33.3
	Critical	4	66.7	66.7	100.0
	Total	6	100.0	100.0	

q51n Management skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	2	33.3	33.3	33.3
	Very Important	2	33.3	33.3	66.7
	Critical	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q51o Marketing & Sales

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	2	33.3	33.3	33.3
	Very Important	2	33.3	33.3	66.7
	Critical	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q51p Mathematics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Important	1	16.7	16.7	16.7
	Very Important	4	66.7	66.7	83.3
	Critical	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q51q Physics/Chemistry/Science

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Important	1	16.7	16.7	16.7
	Somewhat Important	4	66.7	66.7	83.3
	Critical	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q51r Quality Assurance/Control

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Important	3	50.0	50.0	50.0
	Very Important	1	16.7	16.7	66.7
	Critical	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

q52 Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	83.3	83.3	83.3
	The down side to the HVACR program was administrative short comings. For example we could not enroll in classes our selves because the classes would show they were reserved, but we also were not automatically enrolled each semester; we had to email the coordinator to say please enroll me this semester. This process was never explained and was quite confusing at first. In addition I feel there needs to be considerably more communication about the requirements and process for graduation. I felt like it was pulling teeth to get information on were I stood for graduating.	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q53 Name

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Aaron Cooper	1	16.7	16.7	16.7
	Ali Ali	1	16.7	16.7	33.3
	Brian	1	16.7	16.7	50.0
	Justin Miller	1	16.7	16.7	66.7
	Leroy Simms Jr.	1	16.7	16.7	83.3
	Michael Convery	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q54 Home address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	16.7	16.7	16.7
	1607 coit ne	1	16.7	16.7	33.3
	1821 Conowingo Road	1	16.7	16.7	50.0
	3631 Brandon Gate Drive, Mississauga, ON L4T 3E4	1	16.7	16.7	66.7
	5325 Sandpiper Lane, La Crosse, WI 54601	1	16.7	16.7	83.3
	804 Arbor Creek Dr., Apt. 101, Holland, MI 49423	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q55 Home phone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	16.7	16.7	16.7
	248-875-1429	1	16.7	16.7	33.3
	4106381490	1	16.7	16.7	50.0
	608-797-9468	1	16.7	16.7	66.7
	616-375-4586	1	16.7	16.7	83.3
	647 898 562	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

q56 E-mail address

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	16.7	16.7	16.7
	Aaroncooper68@yahoo.com	1	16.7	16.7	33.3
	alia3@ferris.edu	1	16.7	16.7	50.0
	evilways1@gmail.com	1	16.7	16.7	66.7
	michael.john.convery@gmail.com	1	16.7	16.7	83.3
	slsimms@netzero.net	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

FERRIS STATE UNIVERSITY
HVACR Program Review
Employer Perception of the HVACR Programs

STUDENT SURVEY

	Please Rate the Following:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	No Opinion
		SA	A	N	D	SD	?
	COURSES IN YOUR PROGRAM AREA ARE:						
1	Available and conveniently located	5	4	3	2	1	?
2	Based on realistic prerequisites	5	4	3	2	1	?
	WRITTEN OBJECTIVES FOR COURSES IN YOUR PROGRAM:						
3	Are available to students	5	4	3	2	1	?
4	Describe what you will learn in the course	5	4	3	2	1	?
5	Are used by the instructor to keep you aware of your progress	5	4	3	2	1	?
	TEACHING METHODS, PROCEDURES & COURSE CONTENT:						
6	Meet your projected career needs, interests and objectives	5	4	3	2	1	?
7	Provide supervised practice for skill development	5	4	3	2	1	?
	PROGRAM FACULTY:						
8	Know the subject matter and occupational requirements	5	4	3	2	1	?
9	Are available to provide help when needed	5	4	3	2	1	?
10	Provide instruction so it is interesting and understandable	5	4	3	2	1	?
	RELATED COURSE FACULTY						
11	Know the subject matter and occupational requirements	5	4	3	2	1	?
12	Are available to provide help when needed	5	4	3	2	1	?
13	Provide instruction so it is interesting and understandable	5	4	3	2	1	?
	PROGRAM COMPUTER LABORATORIES						
14	Provide adequate lighting, ventilation, etc.	5	4	3	2	1	?
15	Include enough work stations for students enrolled	5	4	3	2	1	?
16	Are safe, functional, and well maintained	5	4	3	2	1	?
17	Are available on an equal basis for all students	5	4	3	2	1	?
	OTHER PROGRAM LABORATORIES						
18	Provide adequate lighting, ventilation, etc.	5	4	3	2	1	?
19	Include enough work stations for students enrolled	5	4	3	2	1	?
20	Are safe, functional, and well maintained	5	4	3	2	1	?
21	Are available on an equal basis for all students	5	4	3	2	1	?
	PROGRAM INSTRUCTIONAL EQUIPMENT IS:						
22	Current and representative of the industry	5	4	3	2	1	?
23	In sufficient quantity to avoid long delays in use	5	4	3	2	1	?
24	Safe and good condition	5	4	3	2	1	?

STUDENT SURVEY

	Please Rate the Following:	Strongly Agree SA	Agree A	Neutral N	Disagree D	Strongly Disagree SD	No Opinion ?
	INSTRUCTIONAL MATERIALS ARE:						
25	Current and meaningful to the subject	5	4	3	2	1	?
26	Available and conveniently located for use	5	4	3	2	1	?
	INSTUCTIONAL SUPPORT SERVICES (TUTORING) ARE:						
27	Available to meet your needs and interests	5	4	3	2	1	?
28	Provided by knowledgeable, interested staff	5	4	3	2	1	?
	PLACEMENT SERVICES ARE AVAILABLE TO:						
29	Help you find employment opportunities:	5	4	3	2	1	?
30	Prepare you to apply for a job	5	4	3	2	1	?

Answer the following questions:

31. What are the HVACR programs greatest strengths? ______________________________

____

32. What are the HVACR programs greatest weaknesses? ______________________________

____

33. Which course would you consider least valuable in the HVACR Program and why?__________

____

34. Are you a transfer student? ❒ YES ❒ NO

35. If you are a transfer student from what school and curriculum?______________________

____

36. What year in the program are you? ❒ First ❒ Second ❒ Third ❒ Fourth

37. Use the remaining space below to add any additional comments that would be helpful in evaluation the HVACR Programs: ____

____

____

FERRIS STATE UNIVERSITY
HVACR Program Review
Faulty Perception of the HVACR Programs

FACULTY SURVEY

Survey Statement:	Strongly Agree SA	Agree A	Neutral N	Disagree D	Strongly Disagree SD	No Response NR
1. The Granger Center facilities are adequate.	5	4	3	2	1	NR
2. The student advisory loads are reasonable.	5	4	3	2	1	NR
3. The HVACR Dept. is well represented on the CET Curriculum Committee.	5	4	3	2	1	NR
4. The HVACR Dept. is well represented on the promotion committee.	5	4	3	2	1	NR
5. The HVACR curriculum review process is effective.	5	4	3	2	1	NR
6. There are sufficient meeting times for the HVACR faculty.	5	4	3	2	1	NR
7. Course assignments are appropriate.	5	4	3	2	1	NR
8. Course assignments are equitable.	5	4	3	2	1	NR
9. Faculty teaching loads are appropriate.	5	4	3	2	1	NR
10. Course textbook approval policy is appropriate.	5	4	3	2	1	NR
11. Travel funds are sufficient.	5	4	3	2	1	NR
12. Representation in professional societies by faculty is appropriate.	5	4	3	2	1	NR
13. The Chair has done an effective job.	5	4	3	2	1	NR
14. The HVACR Dept. receives a proper share of CET resources.	5	4	3	2	1	NR
15. The HVACR Dept. has enough visibility in the HVACR industry.	5	4	3	2	1	NR
16. The HVACR Dept. advisory board does an effective job.	5	4	3	2	1	NR

17. List (at least) the 3 most positive features of being a faculty member in the HVACR Dept.

____

____

____

18. List (at least) the 3 most negative aspects of being a faculty member in the HVACR Dept.

____

____

____

FACULTY SURVEY

19. Describe the most significant accomplishments of the HVACR Dept. in the past few years.

20. What are your thoughts on the HVACR Dept. mentoring process for tenure.

21. Please discuss any other item(s) of concern.

FERRIS STATE UNIVERSITY
COLLEGE OF TECHNOLOGY
CONSTRUCTION DEPARTMENT
HVACR PROGRAMS

April 15, 2012

Dear Ferris HVACR Program Advisory Board Member:

Ferris State University Could Enhance the HVACR Programs! We Need YOUR Input!

The University's Academic Program review Committee is reviewing our HVACR Programs. As a member of the Ferris State University HVACR program advisory board, we need your viewpoint! The results of this review can range from increasing our programs' resources, to placing the program in a probationary status. Here is where you can voice your opinions and with your input the faculty can be proactive for advancing the HVACR program and degrees. This process requires your **input!**

Note: The result of the program review in 2000 resulted in a **new building for the HVACR Programs**, your input is taken very seriously by the University!

In advance, we thank you for your quick response.

Sincerely,

Douglas F. Zentz
HVACR Programs Coordinator
Associate Professor

Enclosed: Advisory Board Member Survey

Advisory Board Perceptions

Page 1

Name: *Title:*

Respond to the following statements:	Strongly Agree SA	Agree A	Neutral N	Disagree D	Strongly Disagree SD	Not Applicable NA
1 The advisory committee is diversified enough to meet the needs of what is taught in the program Comments:	5	4	3	2	1	NA
2 The advisory committee meets appropriately each school year Comments:	5	4	3	2	1	NA
3 The program/Univeristy adequately utilizes the advisory committee Comments:	5	4	3	2	1	NA
4 The advisory committee members are knowledgeable about the program Comments:	5	4	3	2	1	NA
5 Suggestions from the advisory committee are encouraged and adopted by the program Comments:	5	4	3	2	1	NA
6 The program has adequate lab facilities Comments:	5	4	3	2	1	NA
7 The program has adequate computer facilities Comments:	5	4	3	2	1	NA
8 The program has adequate financial support from the University Comments:	5	4	3	2	1	NA
9 The program has adequate financial support from industry Comments:	5	4	3	2	1	NA
10 The graduates from the program are adequately prepared to go to work Comments:	5	4	3	2	1	NA
11 The program curriculum meets the needs of the industry	5	4	3	2	1	NA
Comments:	5	4	3	2	1	NA
12 The program has an adequate number of graduates Comments:	5	4	3	2	1	NA
13 The program has an adequate number of faculty Comments:	5	4	3	2	1	NA
14 The faculty in the program have adequate expertise Comments:	5	4	3	2	1	NA
15 Your company would hire a student from this program Comments:	5	4	3	2	1	NA
16 Faculty in the program keep-up with changing technologies Comments:	5	4	3	2	1	NA

Advisory Board Perceptions

Respond to the following statements:	Strongly Agree SA	Agree A	Neutral N	Disagree D	Strongly Disagree SD	Not Applicable NA
17 The program has current and adequate instructional equipment to teach with Comments:	5	4	3	2	1	NA
18 The graduates of the program are competitive with graduates of similar programs from other universities or community colleges Comments:	5	4	3	2	1	NA
19 The program is doing all it can to recruit new students Comments:	5	4	3	2	1	NA

20 What is the strongest part of the current HVACR Associate Degree?

21 What is the strongest part of the current HVACR Bachelor Degree?

22 If you were to add or change any one element of the HVACR Program, what would it be?

Please use the space below to add further comments:

FERRIS STATE UNIVERSITY
Imagine More

Associate in Applied Science

HVACR Technology

Course Sequence Guide

Student:			
Email:		ID:	
Advisor:		Ph:	

YEAR 1 - FALL SEMESTER			Crs	Gr
HVAC	101	Introduction to Refrigeration & A/C Systems (co-req MATH 116)	4	
HVAC	111	Electricity-Blueprints-Fabrication (co-req MATH 116)	4	
MATH	116	Intermediate Algebra & Numerical Trigonometry (C- in MATH 110 or 19 ACT)	4	
ENGL	150	English 1	3	
FSUS	100	FSU Seminar	1	
		Total	16	

YEAR 1 - SPRING SEMESTER			Crs	Gr
HVAC	102	Advanced Refrigeration & A/C (C- or better in HVAC 101, 111 and MATH 116)	4	
HVAC	117	Advanced Electricity-Circuits (C- or better in HVAC 111 and MATH 116)	4	
HVAC	132	Fund of Heating & Mechanical Systems (C- or better in HVAC 111, MATH 116)	5	
		Scientific Understanding Elective (PHYS 130 or 211, CHEM 103, 114 or 121, or BIOL 111. Must Include a Lab Section)	4	
		Total	17	

YEAR 2 - FALL SEMESTER			Crs	Gr
HVAC	235	Advanced Heating-Mechanical Systems (C- or better in HVAC 117, 132)	5	
HVAC	245	HVAC Unitary System Design (C- or better in HVAC 101, 132)	4	
ISYS	105	Microcomputer Applications	3	
ENGL	211	Industrial and Career Writing (ENGL 150)	3	
		Cultural Enrichment Elective	3	
		Total	18	

YEAR 2 - SPRING SEMESTER			Crs	Gr
HVAC	207	Commercial Refrigeration Systems (C- or better in HVAC 102, 117)	5	
HVAC	208	Air Conditioning Applications (C- or better in HVAC 102, 117)	5	
COMM	121	Fundamentals of Public Speaking	3	
		Social Awareness Elective	3	
		Total	16	

AAS Minimum General Education Requirements

Cultural Enrichment (CE) - 3 credits, Social Awareness (SA) - 3 credits, Communications - 6 credits, Scientific Understanding - 3-4 credits

Reference: gttp://www.ferris.edu/htmls/academics/gened/gen_edspecific.htm

FERRIS STATE UNIVERSITY
Imagine More

Bachelor of Science Degree

HVACR Engineering Technology and Energy Management

Course Sequence Guide

Student:			
Email:		ID:	
Advisor:		Ph:	

YEAR 3 - FALL SEMESTER			Crs	Gr
HVAC	331	Secondary System Select-Design (Admission to BS in HVACR Engineering Technology)	4	
HVAC	342	Load Analysis & Energy Modeling (Admission to BS in HVACR Engineering Technology)	4	
ARCH	110	Intro to Computer Graphics in ARCH for HVACR Students	2	
MATH	126	Algebra & Analytical Trig. (MATH 116)- (Students who took MATH115 shall take MATH120)	4	
		Social Awareness Elective	3	
		Total	17	

YEAR 3 - SPRING SEMESTER			Crs	Gr
HVAC	312	Control Theory & Application (C- or better in HVAC 331, HVAC 342, and MATH 116 or 120)	4	
HVAC	350	Contracting Issues in HVACR (C- or better in HVAC 331, HVAC 342, and MATH 116 or 120)	4	
HVAC	362	Primary Equipment Selection (C- or better in HVAC 331, HVAC 342, and MATH 116 or 120)	4	
		Scientific Understanding Elective	4	
MATH		Students who took MATH 115 and MATH 120 shall take MATH 130		
		Total	16	

YEAR 3 - SUMMER SEMESTER			Crs	Gr
HVAC	393	Summer Internship (C- or better in HVAC 312, 350 & 362)	4	
		Total	4	

Submit Application for Graduation.

YEAR 4 - FALL SEMESTER			Crs	Gr
HVAC	415	Direct Digital Control (C- in MATH 126 or 130, and HVAC 393)	4	
HVAC	451	Energy Audit and Analysis [WIC] (C- in MATH 126 or 130, and HVAC 393)	4	
COMM	221	Small Group Decision Making	3	
		Cultural Enrichment Elective	3	
		Total	14	

YEAR 4 - SPRING SEMESTER			Crs	Gr
HVAC	499	Commercial HVAC System Design [WIC] (C- or better in HVAC 415 and 451)	5	
ECON	221	Principles of Economics 1	3	
		Cultural Enrichment Elective	3	
		Directed Elective	3	
		Total	14	

Students must complete 40 credits at or above the 300 level in the bachelor program. Three credits of 300 level coursework must be t in the social awareness and/or cultural enrichment courses to meet this requirement. From among the cultural enrichment and soci awareness coursework, at least one global consciousness course and one REG course must be taken.

Section 3 - I:
Item 1b: Learning outcomes at the course level

A.A.S. HVACR Technology Program

Course: HVAC 101 Introductions to Refrigeration and Air Conditioning Systems

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction A. Demonstrate safe practices related to personal, electrical, refrigerant and tool sa every day while working in the lab. B. Demonstrate competent operation of hand tools and instruments.
II.	History and Development of Refrigeration A. Describe early developments in refrigeration, refrigerants and oils and the economic drive behind refrigeration.
III.	Heat, Matter & Temperature A. Describe the basic structure of matter using the terms protons, neutrons and electrons. B. Describe the relationship between molecular motion and heat. C. Define the British Thermal Unit (BTU) D. Define enthalpy and use enthalpy to measure heat E. List the specific heat of water and air F. Define sensible and latent heat using enthalpy of water from 0^0F to 230^0F. G. Apply the basic heat formula, BTU = lb x delta T x specific heat
III.	Heat, Matter & Temperature – cont. H. Define modes of heat transfer (convection, conduction, radiation) and list examples of each. I. Calculate energy and power conversions using common units of measure, such as BTU, watt, horsepower. J. Explain the difference between temperature and heat. K. Describe the difference between the temperature scales Fahrenheit, Centigrade, Kelvin and Rankin. L. Convert temperatures between the scales of Fahrenheit, Centigrade, Kelvin and Rankin.
IV.	Pressure A. Describe the difference between atmospheric, absolute and gauge pressure. B. Define common units of measure for pressure used in the HVACR industry (psi, mm HG, in water column). C. Perform pressure conversions (absolute, gauge, psi, mm HG, in water column). D. Install pressure gauges. E. Repair Schrader valves. F. Use three-way valves. G. Apply gas laws for problem solving and calculation.

V.	Refrigeration System A. Identify and explain the function of the evaporator, compressor, condenser, metering device and interconnection tubing. B. Describe the state of refrigerant within each component, including liquid, vapor and saturation points. C. Explain subcooled and superheated conditions and describe where, how, when and why they occur. D. Describe the "sequence of operation".
VI.	Refrigerants A. Illustrate and describe the molecular structure of several common refrigerants, including CFC's, HCFC's, HFC's. B. Determine the properties of any given refrigerant, using reference materials. C. Define and describe saturation point. D. Determine the temperature/pressure relationship for any given refrigerant. E. List typical applications for any given refrigerant. F. Accurately determine temperature pressure relationships using an operating refrigeration system and a pressure temperature chart.
VII.	Thermodynamic Laws A. Describe how heat transfer takes place throughout a mechanical refrigeration system by explaining where, how, when and why energy is absorbed by the system, rejected from the system and moved throughout the system.
VIII.	Manifold gauges, Service valves & Manufacturers Data Plates A. Identify manifold gauge components using proper terminology. B. Read pressure and temperature on gauge dial. C. Properly purge hoses prior to connecting to system, charging cylinder or other device. D. Properly connect manifold gauges to various service valves, charging cylinders and other devices. E. Properly operate manifold gauges and service valves for evacuation, charging, recovery, adding oil, etc.
VIII.	Manifold gauges, Service valves & Manufacturers Data Plates – cont. F. Determine model number, running specifications, electrical specifications, RSIR-CSIR, voltage application, RLA, LRA, refrigerant, temperature application, capacity-mechanical abilities and warranty information from manufactures data plates.
IX.	Vacuum pumps & recover/reclaim/recycle equipment A. Identify and describe the variation of designs and efficiencies of various vacuum pumps. B. Properly change lubricating oil and maintain vacuum pumps. C. Explain the purpose of drawing a vacuum on a refrigeration system. D. Describe the importance of hermetic system with no leaks prior to evacuation. E. Draw the required vacuum on a refrigeration system under various ambient conditions to attain dehydration. F. Use proper vacuum pump hoses due to permeation and hose length. G. Apply heat sources to aid dehydration and explain why the application of head aids dehydrations. H. Explain the purpose for "blotting" if used and a holding charge if necessary demonstration. I. Successfully perform recovery/reclaim/recycle procedures per instruction and demonstration.

X.	Use of and Transfer of Refrigerant to Charging Cylinders A. Demonstrate refrigerant safety precaution and procedures for safe handling of storage cylinders. B. Fill a charging cylinder to a specified level using proper procedures and safety techniques. C. Add a specified amount of refrigerant to a system using a charging cylinder.
XI.	Ammeter use, Cap Tube Systems A. Determine the full load amps of an operating system using proper procedures and safety techniques. B. Monitor and maintain safe ampere draw level through varying conditions of system load and charge. C. Test, operate, analyze and adjust a capillary tube system a. Analyze the effects created by restrictions, improper charge, inefficient compressor & improper air flows. D. Demonstrate safe methods of transferring refrigerants. E. Successfully pull a deep vacuum on the system using a vacuum pump and micron gauge. F. Leak check a system using acceptable and current technologies and practices. G. Achieve the critical charge using temperatures and pressure readings with appropriate calculations and system operating data.
XII.	Establishing factory charge and field charging procedure A. Determine the proper charge by reading name plate data. B. Reviewing factory charging and testing procedures in the laboratory. C. Processing using the dial-a-charge. D. Understanding the relationship of saturated vapor point in evaporator. E. Equalizing system pressure prior to start up. F. Preventing liquid admission to low side when a rotary pump is employed. G. Locate the "King" valve and describe it's purpose and operation. H. Properly use portable charging cylinders and employ safety precautions during transport.
XII.	Establishing factory charge and field charging procedure – cont. I. Perform a pump down procedure employing "King" valve. J. Charge liquid into the high side of a system. K. Review TXV operating range according to evaporator temperature.
XIII.	System Components and Application A. List and describe the function and operation of components in a built-up system employing a remote air cooled condensing unit. B. Develop a complete material list of need based upon a sketch of a small AC system. C. Determine the sequence for installation of all components and electrical control of a small AC system. D. Assemble a small AC or refrigeration unit.
XIV.	Leak Checking, Dehydration, Charging, Setup procedures (TXV) A. Check a system for leaks, using various methods. B. Dehydration a system using proper procedures. C. Charge a system using proper procedures to obtain the correct charge. D. Start a system using the startup checkout list and review of service valve positions. E. Install test equipment and measure performance to ensure proper operation of system.

XV.	Food Preservation and Spoilage Agents Along with Related Mechanical and Electrical Sequencing A. Explain food preservation and spoilage from enzymes, microorganisms (mold, yeast and bacteria) relative to refrigeration and other non-cooling methods.

Course: HVAC 102 Advanced Refrigeration & Air Conditioning

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction, Orientation, and Safety. C. Apply all safety procedures required in this course.
II.	Application of Pressure-Heat Diagram (Mollier) into the use of the Thermodynamic tables. B. Collect data for refrigeration analysis. C. Relate test data to Mollier diagram. D. Compare the Mollier diagram to thermodynamic tables. E. Utilize thermodynamic tables for analysis purposes. F. Make conclusions from thermodynamic analysis.
III.	Physical and chemical properties of refrigerants and refrigerant blends. M. Define the various common types of refrigerants. N. Define temperature glide and fractionation. O. Define the dew point, bubble point, sub cooling and superheat of the various common refrigerants.
IV.	Refrigerant Oils. H. Understand the application of the proper oil with refrigerant. I. Understand the properties of the following oils: a. Mineral b. Alkylbenzine c. Esters d. Glycols
V.	Theoretical and actual refrigeration capacities with power requirements. E. Use the formula necessary to prove changes in capacity due to fluctuating operating conditions. F. Use the formula necessary to prove changes in required power to satisfy requirements of capacity. G. Understand the compression process and performance of reciprocating compressions including: a. The compression cycle b. The compressor displacement c. Pressure/volume relationship d. Clearance volume e. Volumetric efficiency and compression ratio f. Suction pressure and discharge pressure effect on compressor capacity g. Liquid slugging
VI.	Pressure drop due to frictional line loss in low side of system. G. Define the effects on capacity and required power due to pressure drops. H. Define effect on system performance due to changes in compression ratio.
VII.	Automated metering devices.

	B. Explain the construction and operation of a Thermostatic expansion valve (TXV). a. Liquid, crossed and gas charged elements b. Externally and internally equalized c. Externally and internally adjustable d. Selection of valves e. Superheat adjustment ranges C. Explain the construction and operation of an Automatic expansion valve. a. Application and operation b. Adjustment method c. Safety precautions (low limit thermostat and back-pressure setting) D. Explain the construction and operation of high and low side floats a. Function and construction of each b. Applications
VIII.	Compressors G. Explain the different types of compressors a. Reciprocating b. Scroll c. Rotary d. Screw e. Centrifugal H. Explain the various types of configurations a. Hermetic b. Semi-hermetic c. Open drive I. Explain the compressor capacity relative to demand of the system a. Increase in suction pressure b. Decrease in suction pressure c. Increase in evaporator air flow d. Decrease in evaporator air flow e. Increase in evaporator coil surface f. Decrease in evaporator coil surface g. Increase in condensing temperature h. Decrease in condensing temperature J. Understand and apply the correct type of lubrication a. Splash lubrication, scoop i. Importance of proper rotation ii. Oil level requirements iii. Oil check valve application and purpose b. Forced-feed, oil pump i. Pump location and construction (gear type or similar) ii. Galleries and internal oil lines c. Centrifugal-type d. Determining oil pressure e. Determining SSV rating and application of oils i. Viscosity, floc-point, cloud point, pour-point ii. Servicing compressor; checking oil level and adding oil K. Define and understand compressor shaft seals; open compressors including: a. Rotary bellows b. Stationary bellows c. Packing gland

<table>
<tr><td></td><td>
d. Diaphragm
L. Understand and explain compressor valve plates
a. Types of valves employed
b. Method of servicing and precautions
c. Determining of a faulty valve plate
d. Causes of valve failure
M. Understand and explain compressor drives
a. V-belts
i. V-belt construction, sizing, application
ii. Pulley alignment
iii. Belt tensioning specs
iv. Determination of driven speed by ratio
b. Direct drive with solid couplers
i. Introduction to dial indicators
ii. Construction features
iii. Installation
iv. Alignment, using dial indicators applied to manufacturers specification.
c. Gear drive
N. Understand and accomplish a compressor disassembling process
a. Care exercised and method
b. Reference to manufacturers' illustrations and specs
c. Care in cleanliness and the use of oil
d. Use of a torque wrench
e. Compressor relief valves
</td></tr>
<tr><td>IX.</td><td>
Determination, cause and cleanup of compressor burnout.
J. Use a Megger to determine winding condition
K. Test oils for acid
L. Perform system cleanup procedure after burnout
M. Determine cause and prevention of compressor burnout
</td></tr>
<tr><td>X.</td><td>
System analysis and system troubleshooting.
D. Analysis and troubleshoot TXV systems
a. System analysis of restrictions, improper charge (sight glass), compressor efficiency.
b. System analysis of improper air flows
E. Develop methods of trouble-shooting
</td></tr>
<tr><td>XI.</td><td>
EPA section 608 certification.
H. Understand and explain all of the material required for EPA section 608 Type I and Type II certification.
</td></tr>
</table>

Minimum Required Student Laboratory Activities

I.	Student will demonstrate safe practices related to personal, electrical and tool safety every day while working in the lab. Student will demonstrate safe and competent operation of hand tools and instruments.
II.	Student will describe the how, why, where and when a refrigerant changes in temperature, pressure, enthalpy, entropy, specific volume and physical state within the components of the refrigeration system while plotting the system on a Mollier diagram. Student will plot a theoretical system on a Mollier diagram, taking into account friction losses due to piping, based on date provided. Student will plot Mollier diagrams of an

	actual system operating in the lab under varying conditions and determine theoretical actual refrigerating capacities, and required power requirements. Student will prove the accuracy of plotted Mollier diagram based on an operating system, using the thermodynamic tables.
III.	Student will list common refrigerants according to CFC, HCFC, HFC, Zeotropic and Azeotropic blends. Student will explain temperature glide and fractionation and apply it to pressure enthalpy diagrams and thermodynamic tables. Student will accurately calculate superheat and sub cooling values, bubble point and dew point.
IV.	Student will explain the reason oil is used in the refrigeration system. Student will explain the properties oil must have in order to be effective in a refrigeration system. Student will explain the reason for the various oils. Student will list the oil to use with each of the refrigerants described above.
V.	Student will prove changes in capacity due to fluctuating operating conditions using given formulae. Student will prove changes in required power to satisfy requirements of capacity using given formulae.
VI.	Student will discuss the pressure drop due to frictional line loss in low side of system by describing the effects on capacity and required power due to pressure drops.
VII.	Student will identify and explain the construction, operation, application, adjustment and selection of various common types of automated metering devices.
VIII.	Student will identify and explain the operation, capacity control, advantages, disadvantages, types of drive and applications of various compressor types. Student will describe the advantages and disadvantages of different compressor configurations, including serviceability and replacement policies. Student will, given lab instruction, reference material and a burned reciprocating compressor, determine winding conditions using a Megger, test oil for acids and demonstrate proper cleanup procedure.
IX. & X.	Student will inspect, identify and analyze a system for the following conditions: overcharged, undercharged, high evaporator air flow, low/no evaporator air flow, high condenser air flow, low/no condenser air flow and system restriction.

Course: HVAC 111 HVACR Electricity, Fabrication, Blueprint Reading, and Sketching

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction, Orientation, and Safety. D. Apply all safety procedures required in this course.
II.	Atomic structure. G. Explain atomic structure to the level of electrons, protons and neutrons. H. Identify the electrical charge of protons, neutrons and electrons. I. Explain electrical flow relative to electrons and coulombs.
III.	Basic DC circuits. P. Explain and sketch series and parallel circuits using symbols for power sources, switches and loads.
IV.	Ohm's Law. J. Apply Ohms by solving for unknown load and circuit characteristics (V, I, R & P.)
V.	Electrical generation and principles.

	H. Explain how single phase and three phase AC electricity is generated through magnetic induction and define the characteristics of the AC voltage source, including generation of sine wave. I. Explain how DC electricity is generated through magnetic induction and through chemical reaction and define the characteristics of DC current.
VI.	AC Sine wave values and characteristics. I. Define the characteristics of frequency, single phase and three phase of an AC circuit. J. Explain what power factor is and how power factor correction capacitors are used to improve power factor.
VII.	Metal types and Gauges. E. Identify samples of galvanized sheet metal. F. Determine the gauge of various samples of galvanized sheet metal.
VIII.	Tools and their uses. O. Properly operate/manipulate had and shop tools per instruction.
IX.	Rigging. N. Will be able to identify and understand the function of common lifting devices including chin falls and gantries. O. Will be able to identify nylon slings and wire rope slings and understand the proper application and use of nylon and wire rope slings and also common rope. P. Will be able to explain common methods employed for moving heavy objects. Q. Will demonstrate ability to signal a crane operator with hand signals.
X.	Edges, Seams and Connections. F. Identify and fabricate the various types of edges, seams and connections used in the sheet metal trade on residential and light commercial ducting.
XI.	Layout of common duct components. I. Layout and fabricate a minimum of the following common rectangular fittings: a. Square and rectangular duct. b. Plenum. c. S & drive end cap. d. 4-drive end cap. e. Round duct. f. Round tap-in. g. Square throat-square heel elbow. h. Square throat-radius heel elbow. i. Radius throat-radius heel elbow. j. Ogee offset. k. Transition. l. On center square-to-round. m. Radius throat, radius heel rectangular change elbow. n. Square to round (on center all-ways). J. Fabricate one complete duct system to specified dimensions, consisting of at least six different duct components from the list above, connected with drive and “S” cleats.
XII.	Job cost estimation. A. Make a cost and material estimation of all material needed to complete a required job, based on a set of mechanical prints with a duct system requiring a heating and cooling system.
XIII.	Fiberglass fabrication techniques. A. Will display ability to fabricate fiberglass ductwork.

XIV.	Manufactured sheet metal fittings & components. A. Identify, connect and install manufactured sheet metal fitting.
XV.	Piping systems and connection methods. A. Identify the fittings by size and their use and application in a piping system. B. Measure, cut, thread, and assemble black or galvanized pipe and pipe fittings to sizes and directions indicated on the print given. C. Copper/brass tubing and fitting joining techniques. D. Identify (by name and size) standard forged brass and wrought copper refrigeration fittings utilized on domestic refrigeration and air conditioners and small commercial refrigeration systems. E. Ignite an oxygen and acetylene torch and adjust the flame to the proper type of flame and the proper heat to solder or braze a tubing project so it will be gas or liquid tight. F. Demonstrate soldering, brazing and tube working skills. G. Demonstrate plastic tubing/pipe joining techniques. H. Glue various plastic (PVC) tubing and fittings to accurately assemble a piping system according to a drawing. I. Demonstrate joining techniques for dissimilar materials. J. Accurately fabricate and assemble a copper, iron and plastic tubing/pipe system comprised of copper, iron and plastic tubing/pipe and fittings according to a drawing and pressure test the system to a pressure of 15 psig in a bath of water to verify that no leaks exist.
XVI.	Drawing and plan reading. A. Sketch orthographic views of the object based on an isometric view. B. Sketch an isometric view of an object based on orthographic view. C. Given a set of building prints the student will be able to understand how the building is constructed, what symbols are used in the making and drawing of blueprints. D. Locate and identify all the mechanical components of a system on a blueprint. E. Determine sizing of pipes and ducting on mechanical drawings. F. Determine joining techniques of piping and ducting from blueprints. G. Locate listings of pumps, valves, fans and other mechanical components on mechanical schedules. H. Accurately locate and interpret drawings of building sections and details on mechanical and building prints. I. Locate requested information in a specification book. J. Accurately read dimensions of various scales using an architect's scale.
XVII.	Conduit bending. A. Display ability to measure, cut and assemble conduit to match dimension provided.
XVIII.	Supports and fasteners. A. display ability to identify common support steel and fasteners.

Minimum Required Student Laboratory Activities

I.	Student will demonstrate safe practices related to personal, electrical and tool safety every day while working in the lab. Student will demonstrate safe and competent operation of hand tools and instruments.
III.	Student will design and construct DC series, parallel and series/parallel circuits, and

	calculate and measure circuit characteristics (V, I, R & P.)
IV.	Student will measure voltage, voltage drop and current according to Ohm's Law using digital and analog multi-meters and design and build voltage divider circuits.
VI.	Student will calculate and plot AC series, parallel and series/parallel circuits. Wire multi-tap transformer for proper primary and secondary voltage.
IX.	Student will demonstrate ability to signal a crane operator with hand signals.
X., XI., XIII., XIV., XV.	Student will layout and fabricate a variety of duct fittings and duct material types.
XVI.	Student will work with a variety of blueprint, design sketches and schematics.

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Course: HVAC 132 Fundamentals of Heating and Mechanical Systems

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction, Orientation, and Safety. E. Apply all safety procedures required in this course.
II.	Combustion chemistry. J. List the components needed for combustion. K. List the products of combustion. L. Describe the requirements and the process of combustion. M. List the heating values of common fuels used in the heating industry (methane, natural gas, propane, fuel oils, etc.) N. List the flame temperatures and flame speeds of common fuels used in the heating industry. O. Determine combustion air requirements for common fuels used in the heating industry. P. Explain the reason for excess oxygen used in the combustion process.
III.	Gas fired systems. Q. Identify and describe various gas valve types and their operation, including solenoid, mechanical, pilot-operated and combination. R. Identify and describe pilot and proving devices and their operation, including standing pilots, thermocouple and millivolt systems, gas-filled tube and relay, pilot switch, and electronic flame rectification. S. List common manifold pressures for various gas heating devices.
IV.	Forced-air furnace. K. Describe various heat exchanger types used in forced air furnaces. L. Describe the difference between an atmospheric burner and a power burner. M. Describe the difference between forced and induced draft. N. Describe the function and sequence of operation of a simple thermostat. O. Describe the function and sequence of operation of the fan control. P. Describe the function and sequence of operation of the fuel control. Q. Describe the function, sequence of operation and application of the standing pilot (aerated and non-aerated). R. Describe the function, sequence of operation and application of various ignited pilot systems, including the electric spark, glow coil and hot surface ignition.

	S. Describe the function, sequence of operation and application of various direct ignition systems, including the direct spark ignition (DSI) and hot surface ignition. T. Describe the function, sequence of operation and application of various flame-proving devices, including thermocouples, thermopiles, bimetallic strips, mercury bulbs and flame rectifiers. U. Describe the function and sequence of operation of the lockout relay. V. Describe the function and sequence of operation of the blower door switch. W. Describe the function, the sequence of operation and application of limit and auxiliary safety devices, including the high limit, the flame rollout, the airflow switch. X. Describe the function and sequence of operation of the main blower. Including various types (constant speed, multi-speed and variable speed). Y. Describe the function of the transformer. Z. Describe the function of the manifold. AA. Describe the function of filters and list several common filters used on furnaces. BB. Describe the functions of the supply and return air plenums. CC. Describe the basic electrical operation of a forced air furnace to include call for heat, ignition, safeties and satisfied condition. List the controllers, actuators, and safety devices used in the sequence of operation, and describe the function of each. DD. List the typical percentage of efficiency of a standard and high efficiency furnace, as well as the pulse and condensing models and describe how the efficiencies are achieved. EE. Describe the venting requirements for the various models of furnaces. FF. Describe the basic mechanical operation of a forced air system to include pressure regulators, types of fuel metering devices and pressure setting and draft.
V.	Combustion air. J. Describe the code requirements, design and sizing of proper combustion air.
VI.	Airflow and air pressures. K. Describe external static pressure and air volume measurements. L. Describe air volume and pressure testing tools. M. Describe the basic fan laws. N. Be able to use the fan law equations to solve related problems.
VII.	Make-up air units. G. Define system types and air side configurations including: 100% outside air, constant volume, recirculation, variable air volume, direct fired and indirect fired. H. Describe various application: direct fired and indirect fired. I. List all electrical, mechanical and gas burner components. J. Describe fan and blower types: forward curved, backward incline and backward incline airfoil. K. Define sequence of operations for typical winter and summer operations. L. List common problems and troubleshooting steps. M. Describe energy conservation modification and recommendations: air balance investigation, code compliance, recirculation and control system upgrades.
VIII.	Larger burner gas train assemblies. P. List approval agencies. Q. Define electrical and mechanical components. R. Define the sequence of operation.
IX.	Flame safeguard systems.

	R. Define types, functions, sequence of operations. S. List flame detector types: ultraviolet, flame rectification. T. Describe wiring diagrams and troubleshooting steps.
X.	Customer relations. G. Define the importance of image, verbal communications and conflict resolution.
XI.	Sales. K. Define site surveys, material estimates, labor estimates and proposals and contracts. L. Describe the importance of listening and speaking skills and closing strategies. M. Describe presentation methods.
XII.	Digital Controls. A. Define the various terminology used in the digital control industry. B. Describe the various components that make up a control system. C. Describe the proper wiring practices. D. Describe the method of working with DDC and troubleshooting techniques.

Minimum Required Student Laboratory Activities

I.	Student will demonstrate safe practices related to personal, electrical and tool safety every day while working in the lab. Student will demonstrate safe and competent operation of hand tools and instruments.
II.	Student will analyze the flue gas of an operating heating device to determine carbon dioxide percentage and efficiency.
III.	Student will calculate orifice size of a gas fired heating unit. Using name plate data from a specific unit, determine if the correct size orifices are installed in the unit. Convert a furnace from natural gas to propane or vice versa by resizing the orifices and making the proper pressure adjustments. Student will measure the pressure using a manometer and adjust to proper pressure if necessary. Student will determine the firing rate of a specific heating device and calculate fuel consumption and cost of operation.
IV.	Student will sketch the heat exchanger of a specific furnace and explain how it operates. Student will gather and record data from the manufacturer's name plate, including input and output ratings, blower horsepower, type of gas and amp draw. Student will calculate efficiency using input and output ratings. Given an existing heating unit and the proper charts, the student will collect name plate data, orifice size and operating pressure and determine if the unit is firing correctly. Given an existing heating unit the student will identify all the automatic operating gas valves, determine if each valve is electrically operated or mechanically operated and explain the difference in operation between an electrical and a non-electrical operated gas valve. Student will measure the amperage draw of an electric gas valve. Given an existing heating unit, proper tools and the proper test equipment the student will determine which proving device is being used and test the proving device to determine if it is operating properly (adjust and replace as necessary). Given a high efficiency unit with a condensing heat exchanger etc., the student will explain its operation and the difference between it and a conventional unit. Given an existing heating unit the student will measure temperature rise across the heat exchanger and determine if the rise is within the specifications, if not he will determine why not and correct the problem. Given an existing unit that is not operating properly and the proper tools and test equipment, the student will attempt to fire the unit and observe all oprating and non-operating functions. Through systematic troubleshooting procedures, the student

	will successfully troubleshoot the unit.
VI.	Student will take flow and pressure measurements on an active unit.
VII.	Student will go on a field trip to view various types of make-up air units.
VIII.	Student will go on a field trip to view a large burner gas train.
IX.	Student will analyze and troubleshoot a flame safeguard system.
XI.	Student will develop a material and labor estimate.
XII.	Student will develop a control diagram for a digital controller. Student will field wire and commission a digital controller.

Course: HVAC 117 Advanced HVACR Electricity and Circuits

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction, Orientation, and Safety. F. Apply all safety procedures required in this course.
II.	Alternating current. Q. Define the characteristics of AC run and start capacitors with respect to: construction, operating and troubleshooting characteristics, phase shifts and CEMF. R. Define the characteristics of AC induction motors with respect to: construction, operating and troubleshooting characteristics, CEMF and resulting phase shifts.
III.	AC Capacitor applications. T. Describe the use of capacitors in AC applications, such as starting and running of single phase motors and power factor correction.
IV.	Single phase transformers. GG. Describe the operation and use of single phase transformers for controls, ignition circuits and voltage correction.
V.	Three Phase Transformers. K. Describe the operation and use of delta and wye three phase transformers for power distribution and voltage correction
VI.	AC induction motors. O. Define the characteristics of AC run and start capacitors. P. Define the starting and running characteristics, construction, CEMF and resulting phase shifts of the following motor types: CSIR, CSCR, SP, PSC, Synchronous, Shaded pole and Universal.
VII.	Single phase motor characteristics. N. Define the starting, running and other operating characteristics of AC induction motor starting relays; potential, solid state and centrifugal switches. O. Identify the correct starting relay to use with a specific single phase motor.
VIII.	Three phase motors. S. Explain the purpose, operation and application of wye-delta starting schemes.
IX.	Motor starters. U. Explain the different types and troubleshooting techniques for motor starters.
X.	Wiring diagrams. H. Explain the use of a wiring diagram for troubleshooting.

	I. Explain how to develop a wiring diagram for a piece of equipment.
XI.	Low voltage thermostats. N. Explain how a heat/cool thermostat operates and is properly wired.
XII.	Defrost timer. A. Describe the sequence of operation and application of various types of defrost timers and circuits.
XIII.	Conductor sizing and over current protection. A. Use NEC to properly size wire and describe the problems associated with improperly sized and misapplied conductors. B. Describe operation of various types of circuit breaker, fuses and circuit protectors.
XIV.	Measuring devices. A. Identify and describe the application of thermistors, RTD's, humidity sensors and static pressure sensors. B. Demonstrate knowledge of the operating characteristics and circuits using solid state transducers in HVAC applications. C. Demonstrate knowledge of the proper procedure for troubleshooting solid state control boards by accurately answering homework and test questions. D. Demonstrate knowledge of the proper procedure for troubleshooting solid state control boards by accurately answering homework and test questions.
XV.	Modulating control loops. K. Describe temperature control loop terminology components and operation.

Minimum Required Student Laboratory Activities

I.	Student will demonstrate safe practices related to personal, electrical and tool safety every day while working in the lab. Student will demonstrate safe and competent operation of hand tools and instruments.
VI.	Student will draw the schematic diagram for AC induction motors including: CSIR, CSCR, SP, PSC, Synchronous, Shaded pole and Universal.
VII.	Student will draw the schematic diagram of the AC induction motor starting relays and switches. Student will correctly wire starting relays to appropriate single phase motors. Student will troubleshoot a single phase motor with a faulty starting relay. Student wire a single phase multi tap motor to operate at different specified speeds and reverse rotation. Students will correctly wire a dual-voltage single phase motor for each voltage. Student will troubleshoot a single phase motor to correctly identify faults such as open windings, shorted windings, dirty motor, worn bearings, faulty capacitors and faulty start switches/relays.
VIII.	Student will wire a three phase motor to reverse rotation. Student will correctly wire a dual-voltage three phase motor for each voltage. Student will troubleshoot a three phase motor to correctly identify faults such as open windings, shorted windings, dirty motor, worn bearings. Student will wire both the line and control circuits of a three phase motor starter.
IX.	Student will draw various motor starter circuits complete with overload and auxiliary circuits, including but not limited to: HOA (Hand/Off/Auto), OA, Start/stop, mechanically latched. Student will wire various motor starter circuits and correctly size and overload circuit for a specific motor. Student will troubleshoot starter circuits.
X.	Student will convert a pictorial wiring diagram to a ladder diagram and visa versa. Student will use a wiring diagram to develop a description of operation. Student will develop a pictorial wiring diagram, component schematics and ladder diagram for

	various HVACR equipment using the correct symbols, labels, legends and methodology. Student will wire a system correctly when given a drawing of various heating system components, and convert the pictorial into a ladder diagram. Student will troubleshoot a circuit based on ladder diagram assignments sheets with open and short circuits using a multimeter. Student will determine the wiring configuration of a three-phase power supply.
XI.	Student will correctly develop a schematic of the thermostat and subbase and incorporating them into a ladder diagram of a heating/cooling unit. Student will use a ladder diagram to mount, wire and calibrate a thermostat and subbase and hard wire it to various components in the lab.
XII.	Student will wire a commercial refrigeration defrost timer and the related controls.
XV.	Student will wire and test simple heating and cooling control circuits with high and low limits and minimum position potentiometers using series 90 controls and components.

Course: HVAC 207 Commercial Refrigeration Systems

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction, Orientation, and Safety. G. Apply all safety procedures required in this course.
II.	Review of food preservation issues. S. Relate the temperature, humidity, CO_2, and air velocity to the longevity of food preservation.
III.	Review of compressor types and application in commercial refrigeration. U. Identify and describe commercial refrigeration compressors.
IV.	Compressor safety controls and components. HH. Describe types of oil separators, their application and operation. II. Describe the operation of the oil pump and oil safety control, calculate and read net oil pressure.
V.	System cycling and defrosting controls. L. Describe commercial refrigeration system cycling and defrost controls.
VI.	Water cooled condensers and related components. Q. Describe the operation, water requirements, fouling factors, and service of water cooled condensers and water regulating valves. R. Calculate required water volume for specific capacities of refrigeration.
VII.	Low ambient controllers. P. Describe the operation and application of low ambient control systems.
VIII.	Heat reclaim systems. T. Describe energy conserving systems that are used in supermarkets and other commercial applications.
IX.	Commercial ice machines. V. Describe the operation and application of various types of ice machines, including electrical and mechanical sequences.
X.	Low, medium and ultra-low temp systems, floating head, intercoolers, compound compression, liquid injection and applicable ammonia systems and refrigerants. J. Indentify the types and characteristics of refrigerants used in commercial applications.

	K. Describe the application and operation of ultra-low temperature series (multi-stage) and cascade system.
XI.	Multiple temperature application including suction line control sizing, servicing and maintenance. O. Describe various suction line controllers, their operation and application.
XII.	Equipment performance testing troubleshooting, maintenance and adjustment of electrical and mechanical problems relating to ice makers, walk-ins, aisle cases and reach-ins. A. Describe appropriate steps in troubleshooting of the various refrigeration units mentioned above.
XIII.	Parallel systems and related components. A. Describe operation of various parallel system components.
XIV.	Piping procedures and equipment selection. A. Describe proper piping procedures and equipment selection for various refrigeration units.

Minimum Required Student Laboratory Activities

I.	Student will demonstrate safe practices related to personal, electrical and tool safety every day while working in the lab. Student will demonstrate safe and competent operation of hand tools and instruments.
IV.	Student will identify and describe the application and electrical components found in commercial refrigeration equipment.
V.	Student will properly set low initiation, duration and termination intervals, test and troubleshoot commercial defrost systems on low and medium temperature units. Student will demonstrate the operation, application, and pros and cons of different defrost systems. Student will adjust, test and troubleshoot commercial refrigeration flow control valves, suction pressure regulators, temperature/pressure control.
VI.	Student will adjust and flush water regulating valves.
VII.	Student will adjust low ambient controllers on laboratory equipment.
IX.	Student will determine ice production and perform cleaning, troubleshooting and servicing procedures on various ice machines.
X.	Student will adjust, test and troubleshoot E.P.R. valves. Student will observe actual working system through field trips.
XI.	Student will adjust suction line controller to appropriate box temperature and suction pressure.
XII.	Student will systematically troubleshoot commercial food preservation units with electrical/mechanical problems and repair/replace to restore to original operation. Student will determine the air flow of aisle cases, the type of fans used on the equipment and the rotation of the fan. Student will troubleshoot problems involving air flow of the unit.
XIII.	Student will observe the operation of a parallel refrigeration system during a field trip to a local supermarket.
XIV.	Student will follow appropriate piping procedures when installing equipment. Student will select various system components.

Course: HVAC 208 Air Conditioning Applications

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction, Orientation, and Safety. H. Apply all safety procedures required in this course.
II.	System classification. T. Identify different system classifications of air conditioning equipment and systems.
III.	Psychrometrics. V. Understand the use of a psychrometric chart to analyze the performance of a air conditioning cooling coil and other cooling equipment.
IV.	Air conditioning systems. JJ. Describe the various components, sequence of operation and troubleshooting steps for air conditioning units.
V.	Heat pump systems. M. Explain in dull detail the mechanical and electrical sequence of operation in both the heating and cooling modes of air and water cource heat pumps using flow charts and I/O devices. N. Identify the type of defrost control system and auxiliary heat on air-to-air heat pumps, explain operation and test for correct operation.
VI.	Chillers. S. Describe the application, advantages and disadvantages of chillers. T. Describe the sequence of operation for a chiller. U. Explain chiller safety controls. V. Describe operation and maintenance of a 2-way and 3-way water regulating valve.
VII.	Cooling towers. Q. Describe and demonstrate the operation and maintenance of cooling towers and evaporative condensers. R. Describe the problems and preventative treatment systems involved with scale, corrosion, slime and algae in water cooled equipment.
VIII.	Capacity control. U. Describe operation, advantages and disadvantages of various air conditioning capacity control. V. Describe problems caused by short cycling, compressor capacity control devices and hot gas bypass systems.
IX.	Overload devices. W. Describe the operation, the troubleshooting sequence and the repair/replacement of overload devices such as: a. Solid state time-delay devices. b. Current sensing overload protection devices. c. Thermal overload sensing devices. d. Microprocessor and their input/output devices. e. Identify overload devices on lab equipment.
X.	Centrifugal compressors. L. Describe operation and application and capacity control of centrifugal compressors to include the following in preparation for the EPA Section 608 type III certification: speeds, pressure, reliability, maintenance, capacities and air purgers.
XI.	Screw type compressors.

	P. Describe operation, application and capacity control of screw compressors.
XII.	Absorption refrigeration. B. Describe operation, application and capacity control of an absorption system.
XIII.	Tubing and installation procedures. B. Describe the installation considerations, wiring, air volume requirements and customer relations required to add a split system to a conventional forced air furnace.

Minimum Required Student Laboratory Activities

I.	Student will demonstrate safe practices related to personal, electrical and tool safety every day while working in the lab. Student will demonstrate safe and competent operation of hand tools and instruments.
III.	Student will use a psychrometric chart to analyze the performance of a air conditioning cooling coil and other cooling equipment.
IV.	Student will test compressor windings for moisture and/or acidity using a megohm meter and make maintenance recommendations. Student will perform air and system tests on an operating A/C unit which will include the following: identify capacity of a split A/C unit, calculate operating capacity, compare actual performance to manufacturer's specifications and justify any discrepancies. Student will determine effects in temperature differences, evaporating temperatures and moisture removal of an A/C system. Student will systematically troubleshoot an air conditioning system with electrical, mechanical and/or refrigerant problems.
V.	Student will systematically troubleshoot a heat pump's mechanical and electrical systems. Student will perform air and system tests on an operating heat pump including: calculate BTUH, compare actual performance to manufacturer's specifications and justify any discrepancies, measure water flow on a geothermal heat pump using coil pressure drop and calculate COP and EER.
VI.	Student will select and adjust 2-way and 3-way water regulating valves on an operating system. Student will systematically troubleshoot a chiller's mechanical and electrical system.
VII.	Student will calculate the efficiency of towers and evaporative condensers.
VIII.	Student will set up and operate a capacity control system on a unit in the lab.
X.	Student will observe a centrifugal compressor in operation through a field trip.
XI.	Student will observe a screw compressor in operation through a field trip.
XII.	Student will draw, label and describe the operation of the absorption cycle. Student will observe an absorption chiller in operation through a field trip.
XIII.	Student will perform a start up and commissioning procedure on an A/C unit.
XIV.	Student will perform testing, troubleshooting, maintenance and adjustment of electrical and mechanical problems relating to unitary air conditioning systems.

Course: HVAC 235 Advanced Heating and Mechanical Systems

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction, Orientation, and Safety. I. Apply all safety procedures required in this course.

II.	Operation of high pressure gun type oil burner. U. Explain the parts of a high pressure gun type oil burner and the function of each. V. Describe the sequence of operation of an oil burner, listing each component and its function.
III.	Fuel pumps. W. Explain the functions of the fuel pump used in high pressure gun type fuel oil burners. X. Explain the function of the parts: cleaning section, pumping section and regulating system. Y. Explain the operation, differences and applications of one and two stage fuel pumps. Z. Explain the advantages and disadvantages of one and two line fuel systems.
IV.	Nozzles. KK. Describe the functions of the fuel oil nozzle. LL. Determine the firing rate of a nozzle based on GPH rating. MM. List common spray angles produced by fuel oil nozzles and explain the advantages and disadvantages for the various angles. NN. List common spray patterns produced by fuel oil nozzles and explain the advantages and disadvantages for the various patterns. OO. Select a nozzle with correct GPH, spray angle and spray pattern for a specific unit.
V.	Primary controls. O. Explain the function of a primary control. P. Explain the proper sequence of operation for stack control. Q. Explain the proper sequence of operation of a CAD cell.
VI.	Operation and troubleshooting complete unit. W. Describe the step of systematically troubleshooting a malfunctioning fuel oil unit.
VII.	Combustion chambers. S. Describe the purpose of the combustion chamber. T. List the types of combustion chambers and list the applications of each type. U. Describe the method of sizing a combustion chamber.
VIII.	Combustion testing and efficiency. W. List testing measurements commonly used on fuel oil devices. X. Explain the adjustments that can be made to improve efficiency. Y. Explain the function, operation and application of the barometric damper.
IX.	Hydronics. X. Describe and list the advantages, disadvantages and applications of series loop, one pipe, two pipe direct return and two pipe reverse return piping systems. Y. List piping system components, their function, placement and specifications and settings. Z. Describe the total system operation of the series loop, one pipe, tow pipe direct return and two pipe reverse return piping system. AA. Properly size a specified type of hydronic system, given total load, a list of terminal devices, a list of fittings and components and a heat source (boiler). BB. Determine the piping configuration (series loop, (monoflo), two pipe direct return, two pipe reverse return, or a combination of any of the four) of an existing hydronic system.
X.	Steam. M. Given a specific gauge or absolute pressure, use a steam table to find the corresponding latent heat of vaporization, total heat of steam, specific volume of

	liquid and steam. N. Identify the different components found in a steam system including various types of steam traps and piping configurations specific to steam.

Minimum Required Student Laboratory Activities

I.	Student will demonstrate safe practices related to personal, electrical and tool safety every day while working in the lab. Student will demonstrate safe and competent operation of hand tools and instruments.
II.	Student will verify the proper operation of a high pressure gun type fuel oil burner installed in a specific boiler or furnace. Student will remove and completely disassemble the burner. Student will reassemble the burner and reinstall it, making necessary electrical and fuel connections. Test fire the burner to verify proper operation, using proper safety guidelines.
III.	Student will locate the following components on a fuel pump: cleaning section, pumping section and regulating system. Student will check out, test and adjust a fuel pump. Student will adjust or replace fuel pump components if necessary after checking fro proper cut-off pressure, proper capacity of the pumping gears and suction line leaks.
IV.	Student will remove the nozzle assembly of an existing high pressure gun type fuel oil burner and determine the manufacture of the nozzle, rating in gallons per hour, the spray angle and the pattern of the oil spray.
V.	Student will test a stack control for proper sequence and operation, make any necessary adjustments and determine if the control is faulty. Student will test a CAD cell operated primary control for proper sequence and operation, make any necessary adjustments and determine if the control is faulty. The student will determine if a specific primary control is constant or intermittent ignition and whether the control is a recycling or non-recycling control.
VI.	Student will systematically troubleshoot a malfunctioning fuel oil unit, make necessary adjustments, repairs and replacements, and fire the unit to verify proper operation using the following procedure: obtain the manufacturer's point-to-point wiring diagram, develop an across the line wiring diagram, determine the sequence of operation for the unit, attempt to fire the unit, observe all operating and non-operating functions of the unit, eliminate all components that are not a probable cause, list all components that are probable causes, determine and locate the actual cause using test equipment, make proper adjustments or replace faulty components, fire the unit to verify proper operation.
VII.	Student will analyze a fuel oil unit with a faulty combustion chamber liner and determine if repair or replacement is appropriate, then make the appropriate repair or replace the liner.
VIII.	Student will Measure the flue gas for the following: CO_2, draft and temperature. Student will properly size a chimney for a specific fuel oil device. Student will perform a combustion test and determine combustion efficiency and determine if the efficiency is appropriate for the unit. Student will make proper adjustments or replacements to bring the efficiency to specifications.
IX.	Student will fill an existing hydronic system with water, bleed all air from the system, energize the circulating pump(s) and check all functions to verify proper operation of all components. Student will troubleshoot and repair an existing piping system known to have a fault. Student will perform testing, troubleshooting, maintenance and adjustment of electrical and mechanical problems relating to unitary heating systems.

X.	Student will utilize modern analyzing equipment, determine if a steam trap is working properly.

Course: HVAC 245 Design of Heating, Ventilating, and Air Conditioning Systems

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction, Orientation J. Syllabus
II.	Psychrometrics a. Explain the listed terms and given an example air condition, determine the appropriate value for the following: i. Dry bulb, wet bulb, relative humidity, dew point, humidity ratio, specific volume, enthalpy b. Apply the Psychrometric chart to: i. Determining mass flow rate ii. Determining heating capacity iii. Determining total, sensible, and latent cooling capacity, and sensible heat ratio iv. Determining mixed air properties
III.	Heat transfer a. Define the three methods of heat transfer. b. List the elements of heat loss and heat gain. c. Define "R" and "U" values. d. Convert from R value to U value. e. Apply the basic equation for calculating heat transfer thru building sections. f. Calculate the average U value for a building section with parallel heat flow paths.
IV.	Residential Load Calculations and related energy codes a. Define basic terms related to load calculations b. Explain indoor and outdoor air design conditions and apply weather data c. Complete building envelope heat loss and heat gain load calculations d. Explain ventilation codes, calculations and affects of energy recovery e. Explain infiltration issues, estimation, and measurement methods f. Affects of distribution system on equipment loads g. Complete a manual J load calculation for a residential structure
V.	Residential equipment selection a. Determine airflow requirements b. Explain sizing (capacity) limitations c. Analyze manufacturers detailed capacity ratings d. Explain secondary equipment options for improved indoor air quality e. Complete an equipment selection project
VI.	Residential duct system design a. Explain distribution system classifications and applications for each b. Explain the purpose of manual D procedures

	c. Explain fan performance tables or fan curves and how they are used in duct system design d. Explain friction rate and how friction rate is applied in duct system design e. Explain Total Equivalent Length (TEL) and how TEL is calculated f. Explain the term, Available Static Pressure (ASP) and how ASP is calculated g. Calculate space airflows h. Complete a residential duct system design project
VII.	Commercial Load Calculations a. Explain the differences between commercial and residential load calculations b. Describe internal loads and their affects on commercial buildings c. Explain infiltration for commercial buildings d. Explain ventilation codes and calculations e. Complete a Manual N load calculation project
VIII.	Commercial duct system design a. Apply the equal friction method and simplified method to determine the design friction rate to size ductwork for light commercial duct systems.
VIIII.	Hydronic system design a. Know the formula used to calculate heat flow in hydronic systems and be able to arrange the formula to solve for any unknown. b. Explain the purpose of an expansion tank c. Know the typical operating temperature and pressure range for residential and light commercial systems d. Know the eight common piping arrangements e. Explain primary- secondary pumping arrangements and be able to determine flow thru primary-secondary "tees" f. Explain outdoor reset controls and their purpose g. Determine system head pressure h. Explain pump curves and be able to determine pump performance based on operating pressures i. Be able select a pump based on system requirements j. Complete a hydronic design project

Minimum Required Student Laboratory Activities

I.	No associated laboratory activity
II.	Student will determine properties of air, given any two properties of air. Student will plot the psychrometric process for the following: heating without the addition of moisture, and cooling with dehumidification. Students will plot a mixed air steam process. Students will calculate sensible heating capacity and cooling total, sensible, and latent capacity, and sensible heat ratio.
III.	No associated laboratory activity
IV.	Student will perform a manual and/or computerized heat gain and heat loss calculation for a residential structure.
V.	Student will select residential heating, ventilating and air conditioning equipment for a residential structure
VI.	Student will design a forced air heating and cooling system for a residential home

	given a set of blueprints and accurate load information, exercise will include: sizing and location of terminal devices (supply and return diffusers and registers), size and route ducting, determine flow rate in CFM, Student will determine resistance of various external accessories of ductwork including the ductwork. Students will perform duct sizing using the friction chart and/or duct calculator, relating velocity, CFM, friction loss and area.
VII.	Student will perform a manual and/or computerized heat gain and heat loss calculation for a commercial structure.
VIII.	Student will size ductwork for a small commercial building
VIII.	Student will design a hydronic heating system, determining the zones, controls, manifolds, heat emitter size, flow rate in GPM, pipe and pump sizing and selection.

B.S. HVACR Engineering Technology Program

Course: HVAC 312 HVAC Control Theory & Application

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Terminology K. Understand and apply control terminology. L. Identify control system components by name.
II.	Loop Components W. Identify low and high volume pneumatic control systems. X. Identify process variable and final control device for a specific control loop. Y. Identify a open or closed control loop. Z. Identify a control loop used for safety. AA. Identify the feedback utilized in a control loop. BB. Define the purpose and function of different controllers (pneumatic, electronic)
III.	Elements of a Transfer Function AA. Define, apply and calculate the following terms: a. Throttling range b. Proportional gain c. Proportional band d. Gain e. Error f. Bias g. Setpoint h. Signal path, type and terminations
IV.	Application of a Transfer Function A. Calculate a transfer function for a sensor and then utilize to calibrate the sensor. B. Utilize transfer functions to predict signal values for controllers and final control device positions. C. Apply setpoint reset to multiple applications

V.	Sensors PP. Understand the various types of sensors by point type (analog / digital). QQ. Understand the various types of sensors by output signal (mA, V, ohm, pneumatic, semiconductor) RR. Understand the proper installation, best practice, calibration, handling and termination of sensors of all types. SS. Understand current sensor manufacturer literature. TT. Plot a sensor response in a computer application. UU. Create a spreadsheet for calculating and graphing a linear transfer function.
VI.	Controllers A. Understand the types of controllers (electronic, pneumatic, digital). B. Understand the different modes of control (2 position, timed two position, incremental, Proportional (P), Proportional + Integral (PI), Proportional + Integral + Derivative (PID), Proportional + Derivative (PD). C. Utilize a tuning process to return a process with an unstable controller to a steady state error. D. Identify different loop responses (underdamped, overdamped, critically damped, unstable with increasing amplitude, unstable with constant amplitude) E. Examine linear response and response over time of a control loop.
VII.	Process Characteristics X. Understand process characteristics and terms, such as heat transfer, process time lags, time constant, thermal capacitance and thermal resistance. Y. Understand the affects of time constant on control modes. Z. Understand the affects of thermal capacitance on control modes. AA. Understand the affects of thermal resistance on control modes. BB. Select a controller output based on calculated thermal characteristics of sample spaces.
VIII.	Modulating Final Control Devices V. Understand the various components that make up a control valve. W. Understand the various types of control valves. X. Understand the various ways to connect valves to a system. Y. Understand how various control valves are applied. Z. Understand the following control valve engineering terms: (size, authority, CV). AA. Understand the various components that make up a damper. BB. Understand the various types of dampers. CC. Understand the various ways to connect dampers. DD. Understand how various dampers are applied. EE. Size and select control valves for a sample project.
IX.	Documentation Z. Understand control plans and specifications. AA. Understand, generate and utilize flow charts, point schedules, wiring details and bill of materials. BB. Understand changes made to control documentation, including: RFI, bulletin, addendum. CC. Generate control documentation for a sample project using plans and specs., includes the following documents: a. Flow diagram b. Point schedule c. Wiring detail

	d. Bill of material

Minimum Required Student Laboratory Activities

I.	Identify commercial control components for Air Handling, Hot and Chilled Water systems.
II.	Student will diagram basic control loops for commercial heating, cooling, and ventilation strategies.
III.	Student will perform point verification for Air Handling Unit controls.
IV.	Student will calculate transfer function for several system components.
V.	Student will examine current control literature and graph sensor functions.
VI.	Student will perform point verification for multiple HVAC systems.
VII.	Student will Commission multiple HVAC systems. Student will use Question and Answer programming to create an Application Specific program. Student will examine Proportional and Integral response in a functional loop.
VIII.	Student will assemble and calibrate a pneumatic control loop. Student will examine loop operation and correct mal-functioning loop.
IX.	Student will extract job information from control specifications create a bill of materials, flow diagram with sequence of operation, and point schedule for a control project. Student will then assemble control submittals from previous lab work.

Course: HVAC 331 Secondary Equipment Selection and Design

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction M.
II.	Hydronic System Definition and Classification CC. Classify hydronic systems based upon flow generation, temperature, pressure, piping and pumping arrangement. DD. Explain the advantages and disadvantages of various piping and pumping arrangements. EE. Calculate primary and secondary flowrates and temperatures in primary-secondary pumping arrangements.
III.	Pumps BB. Identify the components and summarize the operation of a centrifugal pump. CC. Explain the relationship between flowrate and total dynamic head in a closed hydronic system. DD. Explain the difference between open and closed hydronic systems.
IV.	Terminal Devices D. Determine type, size and location of finned tube radiation units. E. Determine type, size and location of hot water convector units. F. Determine type, size and location of cabinet unit heaters. G. Determine type, size and location of unit heaters.
V.	Flow Control Devices VV. Explain the application of various service valves in hydronic systems.

	WW. Explain the relationship between heat transfer, temperature differential and flow through a terminal convection element. XX. Explain the relationship between valve port configuration and stem travel. YY. Explain the relationship between energy transfer and valve stem travel for various valve types. ZZ. Define the control flow coefficient (Cv). AAA. Select two-way modulating and three-way mixing and diverting valves using the flow coefficient (Cv).
VI.	Hydronic System Design Procedure F. Calculate the required flow of water for each temperature control zone. G. Determine pipe size required to carry desired water flowrate based upon friction loss and velocity. H. Calculate equivalent length of pipe fittings in piping network. I. Calculate friction loss of piping circuits. J. Determine pressure losses of equipment and terminal units from manufacturer's data. K. Calculate total head loss in closed loop piping systems. L. Use pump affinity laws to plot system curve on pump performance curve for closed loop piping system. M. Select a circulating pump from manufacturer's performance data for closed loop piping system. N. Calculate total head loss in open piping systems. O. Use pump affinity laws to plot system curve on pump performance curve for open loop piping system. P. Select a circulating pump from manufacturer's performance data for closed loop piping system. Q. Select proper motor horsepower for circulating pump from manufacturer's performance data. R. Develop parallel pump performance curves and identify operating points. S. Develop series pump performance curves and identify operating points. T. Analyze the effects of glycol on pump performance. U. Determine the type, size and location of the system expansion tank. V. Utilize manufacturer's computer software to calculate piping system friction loss. W. Utilize manufacturer's computer software to select proper circulating pump. X. Utilize manufacturer's computer software to select proper expansion tank size.
VII.	Balancing Hydronic Systems CC. Identify and summarize the function of instruments used to balance hydronic systems. DD. Determine circulating pump impeller size. EE. Determine actual operating characteristics of circulating pump. FF. Determine flow rates of hydronic circuits using various flow measuring devices. GG. Calculate resistance necessary to pre-balance hydronic circuit. HH. Determine new impeller size to produce required flowrate.
VIII.	Applied Psychrometrics FF. Review of basic psychrometrics. GG. Apply psychrometrics to the air system design process.
IX.	Air System Configuration DD. Describe the components and operating characteristics of a single zone air system.

	EE. Describe the components and operating characteristics of a terminal reheat air system. FF. Describe the components and operating characteristics of a dual-duct air system. GG. Describe the components and operating characteristics of a Multizone air system. HH. Describe the components and operating characteristics of a variable air volume system. II. Describe the components and operating characteristics of a variable volume, variable temperature (VVT) system. JJ. Describe the components and operating characteristics of an induction air system.
X.	Fan Selection and Performance A. Identify tow main categories of fans. B. Describe performance characteristics of forward curve fans. C. Describe performance characteristics of backward inclined and air foil fans. D. Describe performance characteristics of radial blade fans. E. Describe performance characteristics of propeller fans. F. Describe performance characteristics of vane-axial fans. G. Describe performance characteristics of tube-axial fans. H. Select a fan from manufacturer's performance data. I. Use fan laws to plot system curve on fan performance curve. J. Select proper motor horsepower for circulating fan. K. Describe effects of varying fan volume on fan performance curve.
XI.	Ductwork A. Calculate cross-sectional area of a duct. B. Calculate velocity of air in a duct. C. Calculate volume of air in a duct. D. Determine space air flow requirements. E. Determine type, size and routing of duct system (including ventilation air intake and exhaust ducts).
XII.	Air System Pressure Loss Calculations A. Find fitting loss coefficients from tabular data. B. Calculate friction loss in a duct system. C. Utilize manufacturer's computer software to calculate duct system friction loss.
XIII.	Air Diffusion A. Determine type, size and location of diffusers and grilles. B. Determine location and size of ventilation air intake. C. Determine location and size of exhaust air grille.
XIV.	Duct System Design Procedure A. Utilizing all available information design an air system in its entirety (fan to diffuser).
XV.	Air System Testing and Balancing A. Identify and summarize the function of instruments used to balance air systems. B. Determine actual operating characteristics of fans. C. Determine flow rates of air systems using various flow measuring devices. D. Calculate the resistance in a ductwork system.

Minimum Required Student Laboratory Activities

I.	Identify commercial control components for Air Handling, Hot and Chilled Water systems.
II.	Student will diagram basic control loops for commercial heating, cooling, and ventilation strategies.
III.	Student will perform point verification for Air Handling Unit controls.
IV.	Student will calculate transfer function for several system components.
V.	Student will examine current control literature and graph sensor functions.
VI.	Student will perform point verification for multiple HVAC systems.
VII.	Student will Commission multiple HVAC systems. Student will use Question and Answer programming to create an Application Specific program. Student will examine Proportional and Integral response in a functional loop.
VIII.	Student will assemble and calibrate a pneumatic control loop. Student will examine loop operation and correct mal-functioning loop.
IX.	Student will extract job information from control specifications create a bill of materials, flow diagram with sequence of operation, and point schedule for a control project. Student will then assemble control submittals from previous lab work.

Course: HVAC 342 HVAC Load Calculation and Energy Codes

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction N. Define the overview of the load calculation and building simulation process.
II.	Building Heat Transfer FF. Define all the factors that effect heat transfer in a building. GG. Define heat transfer due to conduction HH. Define heat transfer due to convection II. Define heat transfer due to radiation JJ. Define R-value and U-value KK. Calculate total R-value and U-value LL. Define infiltration MM. Define sensible and latent load NN. Define lighting, equipment and people loads
III.	Heat Loss Load Calculations EE. List the total heat gains and heat losses for a net heat loss condition (heating or winter condition). FF. Use the conduction manual formula to calculate a heat loss transfer. GG. Use the convection manual formula to calculate a heat loss transfer. HH. Use reference standards and handbooks to determine R and U values. II. Use reference standards and handbooks to determine design heating weather data. JJ. Perform manual calculations to determine total heat loss for a small building. KK. Perform computer calculation to determine total heat loss for a small building. LL. Use manual calculations to validate the computer data for heat loss.

IV.	Heat Gain Load Calculations H. List the total heat gains and heat losses for a net heat gain condition (cooling or summer condition). I. Use the conduction manual formula to calculate a heat gain transfer. J. Use the convection manual formula to calculate a heat gain transfer. K. Use reference standards and handbooks to determine design cooling weather data. L. Use reference standards and handbooks to determine heat gains from lighting, equipment and people. M. Perform manual calculations to determine total heat gain for a small building. N. Perform computer calculation to determine total heat gain for a small building. O. Use manual calculations to validate the computer data for heat gain.
V.	Psychrometric Process for Equipment Selection BBB. Determine the psychrometric process for a particular system or building design. CCC. Understand the heating psychrometric process. DDD. Understand the cooling psychrometric process. EEE. Using the psychrometric process determine the design entering and leaving coil conditions for design and equipment selection purposes.
VI.	HVAC System Design Y. Outline the basic steps in the HVAC equipment design process. Z. List criteria for system design. AA. List criteria for plant design. BB. List criteria for terminal unit design.
VII.	Energy Estimating Methods II. Define what balance point temperature is. JJ. Define heating degree day and cooling degree day energy estimating method. KK. Using reference sources for heating degree day information, use in a simple energy savings formula. LL. Define what the bin energy estimating method is. MM. Define what the correlation energy estimating method is. NN. Using manufacturers' correlation data, calculate the energy savings in a simple heat loss or gain problem. OO. Describe how computer programs calculate heat loss and heat gain. PP. Using the computer program, calculate the energy saving between two different energy conservation measures.

Minimum Required Student Laboratory Activities

I.	Student will discuss the need for load calculations and energy estimating methods.
II.	Student will diagram the total heat losses and gains for both the summer condition and the winter condition. The student will define and use all of the basic heat transfer formulas.
III.	Student will perform a manual heat loss calculation. The student will perform a computer heat loss calculation.
IV.	Student will perform a manual heat gain calculation. The student will perform a computer heat gain calculation.
V.	Student will plot several psychrometric processes for both heating and cooling applications.
VI.	Student will enter appropriate system, plant and terminal unit design considerations

	into a building simulation program.
VII.	Student will perform several manual energy estimating method calculations on a variety of different systems within a project building. Students will start a real building for future use in the HVAC451 course. All data will be collected and a load calculation run.

Course: HVAC 350 Contracting Issues in HVACR

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Specifications O. Define the divisions and numbering system used in specification. P. Predictably locate specific information using the above system. Q. Identify all new industry specification formats R. Define the role of the Construction Specification Institute in construction documentation. S. Define terms and conditions T. Define cost impact from terms and conditions U. Complete sample documentation including: (method of procedure, AIA billing, approved change orders, insurance needs for material not on site, schedule of values, bulletin, addendum)
II.	Plans OO. Locate and understand abbreviations. PP. Locate and understand symbols. QQ. Utilize abbreviations and symbols in a sample project. RR. Identify types of details and their links to other drawings. SS. Define the use of Mechanical schedules. TT. Use schedules to locate specific mechanical information. UU. Develop a mechanical schedule for a sample project. VV. Locate discrepancies between plans and specs. WW. Identify the cost impact of discrepancies between plans and specs. XX. Define what an addendum is and how it impacts bid form format. YY. Define what a bulletin is and identify situations for use. ZZ. Identify and complete documentation for discrepancy resolution, including: RFI, Bulletin and Addendum.
III.	Estimating MM. Define the different estimating methods: (manual and software). NN. Define scope of work for mechanical trades and identify issues. OO. Complete a scope of work for a sample project. PP. Define a Bid / negotiated job including: bid documents, customer relations, spec. reference to owners authority, issues related to negotiated work. QQ. Define a Design / build job including: advantages / disadvantages, customer relations, code compliance and plan review. RR. Define a Bid / specification job including: sources of opportunity (builders exchange), public vs. private bid, bid requirements (bonding,

	insurance), bid documents, specific issues relative to bid and spec. jobs. SS. Identify issues regarding material, including: billing, shipping, storage, insurance, incorrect, schedule of value and unit pricing. TT. Define what targeted work is and issues including: union vs. private, long term benefits, actual cost of work. UU. Identify equipment needed for job. VV. Identify equipment issues including: responsibility, operating implications, temporary heating, enclosures, unit pricing, warranty start, shipping and availability (job schedule). WW. Perform a mechanical take-off including: piping, duct, controls, primary and secondary equipment XX. Identify labor concerns and issues including: union vs. non-union, prevailing wage, job site foreman, skills needed vs. skill available, per diem. YY. Define the term burden ZZ. Define the term Risk and items associated with the following: designer, mechanical contractor, piping contractor, sheet metal contractor, control contractor, sub-contracted work. AAA. Perform a risk analysis for a sample job. BBB. Define terms and conditions and their implications. CCC. Define warranty and the following issues: jobsite specifics, early equipment start-up, start date, owner acceptance, certificate of occupancy, significant completion and contract requirements. DDD. Identify the roles of general and sub contractors on a job. EEE. Develop a flow chart of job site hierarchy. FFF. Define the risk of sub-contracting. GGG. Identify sub-contactors cost methods including: unit pricing, detailed bid, time and material, single line bid. HHH. Identify site specific requirements including: rough in, minority contracting, scheduling, general terms and conditions, parking, trash removal, after hour work, staging areas, special equipment. III. Identify and define other misc. estimated areas including: drug testing, background checks, safety training, customer training, set up and tear down, trade coordination, weather issues, etc.
IV.	Budget Issues P. Define the process of discovery including customer interview. Q. Develop a quick budget. R. Define risk analysis and thresh hold of risk.
V.	Project Management A. Define the post award of bid steps. B. Define the Project Management Professional (PMP) C. Identify the PMP certificate process D. Develop a project management plan for a sample project. E. Define scope review and identify duplication of responsibility. F. Define scheduling including the following topics: gant schedule, project contractor meeting, manpower, delivery, equipment and critical path. G. Identify and define job documents including: change orders, submittals, bulletin, addendum, bid alternate, RFI, pencil copy, RFP, RFQ, job close out,

	payment app. H. Identify equipment rental needs. I. Identify security and safety issues including compliance and documentation. J. Identify coordination issues with other trades. K. Identify sub-contractor issues and scheduling. L. Define quality control issues. M. Identify personnel issues including: safety, drug screening, job site etiquette.
VI.	Codes and Standards CC. Identify and define the following code and standard organizations: ASHRAE, SMACNA, IESNA, ANSI, OSHA, ISO. DD. Determine the applicable code from local, state, federal, international. EE. Correctly use and interpret a code book. FF. Identify what an inspector wants. GG. Define the term standards of care.
VII.	Economic Analysis QQ. Define the following financial terms: a. Net present value b. Discount rate c. Rate-of-Return (ROR) d. Return-on-investment (ROI) e. Inflation f. Depreciation g. Taxes h. Fuel Cost Escalation RR. Define methods of cash flow analysis including: simple payback, life cycle cash flow analysis (present worth method & annual cash flow method). SS. Utilize available software to perform cash flow analysis.

Minimum Required Student Laboratory Activities

I.	Identify pertinent areas within a specification regarding a specific job.
II.	Student will existing plans to answer job specific question. Student will develop a mechanical equipment schedule.
III.	Student will complete a scope of work, mechanical take-off, risk analysis, develop a and flow chart as key components in an estimate.
IV.	Student will develop a quick budget for a sample job.
V.	Student will layout basic information and concerns for a sample job, including scheduling.
VI.	Student will utilize a variety of codes to comply with a sample job.
VII.	Student will do a manual economic cost analysis on a sample job.

Course: HVAC 415 Direct Digital Control

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction and DDC Background V. Understand course policy and requirements.

	W. Describe the differences, advantages and disadvantages of digital control systen when compared to analog control systems.
II.	Numbering Systems AAA. Demonstrate an understanding of the characteristics and applications of binary numbering systems. BBB. Demonstrate an understanding of the characteristics and applications of octal numbering systems. CCC. Demonstrate an understanding of the characteristics and applications of hexadecimal numbering systems.
III.	Binary Logic JJJ. Demonstrate an understanding of the characteristics and applications of binary logic and logic gates. KKK. Demonstrate an understanding of the characteristics and applications of truth tables.
IV.	Microcomputers / DDC Systems S. Demonstrate an understanding of the characteristics and applications of the following Microcomputer and DDC system components: a. Power supply b. Microprocessor c. Registers d. Memory (RAM and ROM) e. I/O Interfaces (D/A and A/D converters)
V.	Specification and Hardware FFF. Demonstrate an understanding of the process of developing the following: a. Proposal b. Job Prints c. Hardware specifications (cut sheets) d. Description of Operation e. DDC control program GGG. Identify and explain the purpose of various components which make up a DDC system. HHH. Analyze DDC system hardware, software, point operation and field wiring to ensure the lab system is completely operable. III. Identify the different field I/O devices and know the correct way to terminate those devices at the termination board of the DDC system and at the field locations.
VI.	DDC Database Information HH. Describe a DDC database. II. Develop a DDC database. JJ. Program a DDC database.
VII.	Program Statements TT. Understand programming syntax and error resolution. UU. Develop and test software strategies to control various HVAC processes.
VIII.	Writing DDC Programs HH. Develop flowcharts and convert into computer program instruction statements. II. Develop a DDC operating program from a description of operation, using

	correct statements, sequences and syntax.
IX.	Load Management Functions KK. Demonstrate an understanding of the theory, application and software associated with the different energy management strategies, including: a. TOD b. OSS c. DLC d. DC
X.	Downloading Programs A. Download, upload, enable, disable, edit and monitor a DDC program to operate the equipment.
XI.	Loop Editing and Tuning A. Demonstrate the ability to correctly troubleshoot hardware and software problems within a digital control system. B. Tune DDC loops for proper operation
XII.	Archiving Data A. Demonstrate the ability to archive information, set up point monitors and access point to override program control.

Minimum Required Student Laboratory Activities

II.	Student will apply different numbering systems including binary, octal and hexadecimal.
III.	Student will apply binary logic using truth tables and logic gates.
IV.	Student will apply knowledge to various components which make up a microcomputer including the power supply, microprocessor, registers, memory (RAM and ROM), I/O interfaces (D/A and A/D converters).
V.	Student will analyze DDC system hardware, software, point operation and field wiring to ensure the lab system is completely operable.
VI.	Student will identify the different field I/O devices and know the correct way to terminate those devices at the termination board of the DDC system and at the field. Student will accurately program a DDC database.
VII.	Student will develop and test software strategies to control various HVAC processes.
VIII.	Student will develop flow charts and convert the chart into computer program instruction statements. Student will develop a DDC operating program from a description of operation, using correct statements, sequences and syntax.
IX.	Student will apply the theory, application and software associated with the different energy management strategies, TOD, OSS, DLC, and DC.
X.	Student will download, upload, enable, disable, edit and monitor a DDC program to operate the equipment in the lab.
XI.	Student will correctly troubleshoot hardware and software problems within a digital control system. Student will tune DDC loops for proper operation.

XII.	Student will archive information, set up point monitors and access point to override program control.

Course: HVAC 451 Contracting Issues in HVACR

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Units of Energy X. Define the units of energy for various energy sources. Y. Apply the appropriate energy unit in energy calculations.
II.	Energy History / Energy Audit Types / Energy Code / Standards DDD. Explain the recent history of energy conservation EEE. Differentiate between the three types of energy audits (walk thru, mini-audit and technical assistance audit. FFF. Apply the correct energy audit type for a given situation. GGG. Perform all steps in all forms of energy audits. HHH. Utilize current energy codes and standards during the course of an energy audit. III. Make recommendations utilizing current energy codes and standards.
III.	Utility Bill Analysis LLL. Define the various rate structures for electricity. MMM. Calculate an electric bill at various rate structures. NNN. Define the terms demand, kW, capacity and power. OOO. Define the terms electrical use, consumption, kWh and energy. PPP. Define cost recovery factor. QQQ. Define electrical surcharges. RRR. Define and calculate power factor. SSS. Accurately read electrical meters. TTT. Make recommendations on local vs. de-regulated electrical purchase. UUU. Calculate the correct tax exemption status for manufacturing buildings. VVV. Define the various rate structures for gas (natural and propane). WWW. Define the various rate structures for other energy sources. XXX. Use computer spreadsheets to assist in utility bill analysis. YYY. Use utility billing history to establish a utility use baseline. ZZZ. Use utility billing for building comparison to other similar buildings.
IV.	Energy Estimating Methods T. Define, calculate and utilize the degree day method of energy estimating method. U. Define, calculate and utilize the bin energy estimating method. V. Define, calculate and utilize the correlation energy estimating method. W. Define and utilize complex computer energy estimating methods. X. Explain the strengths and limitations of each method.
V.	Envelope, HVAC, Lighting & Other Electric Improvements N. Evaluate a building's envelope and make energy recommendations. O. Evaluate a building's HVAC systems and make energy recommendations. P. Evaluate a building's Lighting and other electrical and make energy recommendations.

	Q. Use various hand calculations to determine energy savings in all the above areas. R. Use computer design and load programs to determine complex energy savings situations for all of the above areas. S. Establish a ranked order of Operation and Maintenance recommendations according to simple payback. T. Establish a ranked order of Energy Conservation Measures according to simple payback.
VI.	Steam Systems KK. Define basic steam principles. LL. Utilize the appropriate steam charts. MM. Recognize and describe various steam systems and components. NN. Evaluate a buildings steam system and make energy recommendations.
VII.	Technical Assist Audit and Class Project VV. Collect on-site data for a technical assist audit. WW. Analyze utility billing for project building. XX. Establish a energy usage history for project building. YY. Place all collected data into a load calculation and computer simulation program. ZZ. Evaluate building envelope, HVAC systems, Lighting and other electrical systems, Control systems for optimal energy efficiency and building performance. AAA. Calculate energy savings for operational and maintenance issues. BBB. Calculate energy savings for energy conservation measures. CCC. Develop a detailed, professional energy audit report. DDD. Deliver the energy audit results in a formal presentation.

Minimum Required Student Laboratory Activities

I.	Student will collect accurate information on a project building, including: envelope data, HVAC data, lighting data, control data, other electrical data, utility data.
II.	Student will use above data, blueprints and building specifications to develop a building simulation.
III.	Student will use various hand calculations to validate the outcome of the computer simulation.
IV.	Student will use the building simulation program to test complex “what if” energy savings measures to determine rank order of payback.
V.	Student will write up a professional energy audit report including the following sections: Building history, Utility history, Computer profile, Mechanical system information, Control information, Lighting & other electrical information, Operational and Maintenance Recommendations, Energy conservation measure recommendations.
VI.	Student will deliver an oral presentation to Ferris staff and students on energy audit findings.
VII.	Student will deliver an oral presentation to the building owner and representatives.

Course: HVAC 462

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction and Primary System Overview Z. Understand course policy and requirements. AA. Define the various categories of primary HVAC equipment, design and selection process and document development.
II.	Chiller Systems JJJ. Define all the types of chiller systems and support components. KKK. Apply and design a chiller system. LLL. Select a chiller system from available vendors. MMM. Develop all documentation for chiller design: piping schematics, chiller schedule, submittal documentation.
III.	Cooling Tower Systems AAAA. Define all the types of cooling tower systems and support components. BBBB. Apply and design a cooling tower system. CCCC. Select a cooling tower system from available vendors. DDDD. Develop all documentation for a cooling tower design: piping schematics, cooling tower schedule, submittal documentation.
IV.	Boiler Systems Y. Define all the types of boiler systems and support components. Z. Apply and design a boiler system. AA. Select a boiler system from available vendors. BB. Develop all documentation for a boiler design: piping schematics, boiler tower schedule, submittal documentation.
V.	Air Handling Units JJJ. Define all the types of air handling units and support components. KKK. Apply and design an air handling unit. LLL. Select an air handling unit from available vendors. MMM. Develop all documentation for an AHU design: piping schematics, AHU schedule, submittal documentation.
VI.	Heat Exchangers OO. Define all the types of heat exchangers and support components. PP. Apply and design a heat exchanger. QQ. Select a heat exchanger from available vendors. RR. Develop all documentation for a heat exchanger design: piping schematics, heat exchanger schedule, submittal documentation.
VII.	Thermal Storage EEE. Define all the types of thermal storage and support components. FFF. Apply and design a thermal storage system. GGG. Select a thermal storage system from available vendor. HHH. Develop all documentation for a thermal storage system design: piping schematics, thermal storage schedule, submittal documentation.
VIII.	Cogeneration JJ. Define all the types of cogeneration and support components. KK. Apply and design a cogeneration system. LL. Select a cogeneration system from an available vendor. MM. Develop all documentation for a cogeneration system: piping

	schematics, cogeneration schedule, submittal documentation.
IX.	Heat Pumps LL. Define all the types of heat pumps and support components. MM. Apply and design a heat pump system. NN. Select a heat pump system from an available vendor. OO. Develop all documentation for a heat pump system: piping schematics, heat pump schedule, submittal documentation.
X.	Economic Analysis B. Define the following financial terms: a. Net present value b. Discount rate c. Rate of return d. Return on investment e. Inflation f. Depreciation g. Taxes h. Fuel cost escalation C. Apply methods of cash flow analysis (simple payback, life cycle cash flow analysis) D. Use current computer programs to do complex cash flow analysis.
XI.	Class Project C. Given a set of building specification: Apply, design, select and develop all documentation for a complete project building HVAC system.

Minimum Required Student Laboratory Activities

II.	Students will select a chiller using vendor software and develop documentation.
III.	Student will select a cooling tower using vendor software and develop documentation.
IV.	Student will select a boiler using vendor software and develop documentation.
V.	Student will select an AHU using vendor software and develop documentation.
VI.	Student will select a heat exchanger using vendor software and develop documentation.
VII.	Student will select a thermal storage system using vendor software and develop documentation.
VIII.	Student will select a cogeneration system using vendor software and develop documentation.
IX.	Student will select a heat pump using vendor software and develop documentation.
X.	Student will use both a manual and computer method to do a cash analysis on a given project.
XI.	Student will design, apply, select and develop all documentation for a given project building.

Course: HVAC 499 Commercial HVAC System Design

Learning Outcomes for Each Instructional Unit

Upon Completion of each Instructional unit, the learner will be able to satisfactorily:

I.	Introduction and Project Overview BB. Understand the purpose and course objectives CC. Understand the project timeline
II.	Design Procedure NNN. Identify the processes of HVAC design
III.	System Analysis and Selection EEEE. Apply factors affecting zoning decisions to system selection. FFFF. Evaluate architectural considerations and its affect upon system selection. GGGG. Evaluate system configuration and performance in relationship to building and zoning considerations. HHHH. Evaluate economics in relationship to budgetary considerations (first cost and operating costs). IIII. Summarize system performance. JJJJ. Identify potential systems to meet performance requirements.
IV.	Base Load Information CC. Indentify indoor design requirements based upon occupancy and applicable codes. DD. Identify indoor air quality requirements.
V.	Miscellaneous Base Load NNN. Describe ventilation characteristics of various systems.
VI.	Initial Design Load SS. Assemble building base load information. TT. Calculate building base load. UU. Assemble building miscellaneous base load information. VV. Calculate miscellaneous base load. WW. Calculate building load.
VII.	Applied Load Analysis A. Understand load analysis terminology. B. Calculate equipment sizing loads. C. Determine ventilation requirements for indoor air quality, economizer and building pressurization. D. Perform load line analysis based upon design load. E. Identify preliminary control strategies and modes. F. Identify methods to control humidity. G. Apply psychrometric analysis.
VIII.	Equipment Selection NN. Identify critical conditions for cooling coil selection. OO. Select cooling coil. PP. Identify miscellaneous accessories. QQ. Select air handling equipment. RR. Select chiller. SS. Select heat rejection equipment. TT. Identify critical conditions for heating coil selection. UU. Select heating coil. VV. Identify miscellaneous heating accessories. WW. Select boiler.

	XX. Identify availability and verify electrical rate structure. YY. Identify availability and verify fossil fuel rate structure. ZZ. Analyze applicability of energy enhancing systems.
IX.	Building Simulation PP. Input utility data. QQ. Input building data. RR. Input plant data. SS. Generate component and annual energy costs.
X.	System Sizing and Layout A. Select size and layout air distribution system. B. Calculate air pressure losses and select fan. C. Select size and layout water distribution system. D. Calculate water pressure losses and select circulating pump.
XI.	Working Drawings A. Identify standards and drawing arrangement. B. Develop working drawings for piping, ductwork, details, schematics and control diagrams and schedules.
XII.	Specifications A. Understand the purpose and format for mechanical specifications. B. Understand the purpose and format for control specifications.

Minimum Required Student Laboratory Activities

I.	Student will identify all critical data needed for the design process (blueprints, specification, weather data, etc.
II.	Student will define and layout the design procedure.
III.	Student will define and outline the system analysis & selection process.
IV.	Student will collect base load information for project building.
V.	Student will collect miscellaneous base load information for project building.
VI.	Student will perform an initial design load calculation.
VII.	Student will analyze all data output from the design load calculation and perform manual validation calculations.
VIII.	Student will select all equipment for the project building.
IX.	Student will run project building simulation using various equipment selections for optimal equipment.
X.	Student will size systems and develop system layouts.
XI.	Student will develop all working drawings, schematics and equipment schedules.
XII.	Student will develop all project specifications and control sequence of operations.
XIII.	Student will develop a professional report defining all design steps, project and operational economics and conclusions.

**Unit Assessment Report - Four Column

Ferris State University

Program - HVACR Technology (A.A.S.)

Mission Statement: HVACR provides quality education and training that emphasizes practical skills, and prepares the student to analyze, synthesize and solve problems. This is accomplished in state-of-the-art facilities with highly qualified instructors.
Advisory Board/Committee Meetings: Twice per year
Next FSU Academic Program Review: 2012-2013
Accreditation Body: N/A
College: CET

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
Program - HVACR Technology (A.A.S.) - Install - Students will demonstrate installation techniques for residential and light commercial HVAC systems. **Outcome Types:** Learning **Start Date:** 01/01/2009 **Outcome Status:** Active	**Assessment Method:** Faculty will observe student in laboratory setting. **Assessment Method Category:** Observations (e.g. Clinical or Field) **Criterion for Success:** Accurate installation of HVAC components.	09/29/2009 - 90% demonstrated proficiency in install outcome 10% Demonstated acceptable skill levels but less than proficent skills **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Faculty will test student in classroom setting. **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score on examination.		
	Assessment Method: Alumni survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - No survey questions provide a basis for analysis. **Classification:** Inconclusive **Action:** 2 - Pending Action	05/29/2012 - Future surveys need to include a minimum of one question clearly related to this topic.
Program - HVACR Technology (A.A.S.) - Service HVAC - Students will service residential and light commercial HVAC	**Assessment Method:** Faculty will observe student in laboratory setting.		

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
equipment. **Outcome Types:** Learning **Start Date:** 01/01/2009 **Outcome Status:** Active	**Assessment Method Category:** Observations (e.g. Clinical or Field) **Criterion for Success:** Accurate installation of HVAC components.		
	Assessment Method: Faculty will test student in classroom setting. **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score on examination.	05/02/2012 - Final exam 54% acceptable **Classification:** Criterion Not Met **Action:** 2 - Pending Action	
	Assessment Method: Alumni survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - 1st Survey topic providing analysis; Commercial Air Conditioning 43.8% very well prepared, 35.4% well prepared, 16.7% fairly prepared, 2.1% barely prepared, 2.1% barely prepared Survey results show 80.2% of graduates have a positive perception of their preparation for this topic. 2nd Survey topic providing analysis; Oil (heating with fuel oil) 29.2% very well prepared, 22.9% well prepared, 27.1% fairly prepared, 14.6% barely prepared, 2.1% poorly prepared Survey results show 52.1% of graduates have a positive perception of their preparation for this topic. 3rd Survey topic providing analysis; gas (heating with gas) 33.3% very well prepared, 37.5% well prepared, 18.8% fairly prepared, 6.3% barely prepared, 0% poorly prepared Survey results show 70.8% of graduates have a positive perception of their preparation for this topic. 4th Survey topic providing analysis; electrical 45.8% very well prepared, 35.4% well prepared, 12.5% fairly prepared, 6.3% barely prepared, 0% poorly prepared Survey results show 81.2% of graduates have a	05/29/2012 - Results show criterion met for all but the fuel oil topic. Heating with fuel oil is declining, however there is still a need to adress this topic in program meetings.

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
		positive perception of their preparation for this topic. **Classification:** Criterion Not Met **Action:** 2 - Pending Action	
Program - HVACR Technology (A.A.S.) - Service Refrigeration - Students will service commercial refrigeration equipment. **Outcome Types:** Learning **Start Date:** 01/01/2009 **Outcome Status:** Active	**Assessment Method:** Faculty will observe student in laboratory setting. **Assessment Method Category:** Observations (e.g. Clinical or Field) **Criterion for Success:** Accurate installation of HVAC components.	11/20/2010 - Fall 2010 semester, HVACR 207, lab exam 84.5% **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Faculty will test student in classroom setting. **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score on examination.	12/03/2010 - HVACR 207 final exam average 78.3% **Classification:** Criterion Met **Action:** 1 - No Action Required	
		10/10/2010 - HVACR 207, exam 1 average 82.4 **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Alumni survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - Survey topic providing analysis; Commercial Refrigeration 37.5% very well prepared, 35.4% well prepared, 20.8% fairly prepared, 4.2% fairly prepared, 0% barely prepared Survey results show 72.9% percent of graduates have a positive perception of their preparation for this topic. **Classification:** Criterion Met **Action:** 1 - No Action Required	

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
Program - HVACR Technology (A.A.S.) - Troubleshoot Refrigeration - Students will systematically troubleshoot and repair commercial refrigeration equipment. **Outcome Types:** Learning **Start Date:** 01/01/2009 **Outcome Status:** Active	**Assessment Method:** Faculty will observe student in laboratory setting. **Assessment Method Category:** Observations (e.g. Clinical or Field) **Criterion for Success:** Accurate installation of HVAC components.		
	Assessment Method: Faculty will test student in classroom setting. **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score on examination.		
	Assessment Method: Alumni survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - No survey questions provide a clear basis for analysis. The best available data is identical to the information shown for service refrigeration. **Classification:** Inconclusive **Action:** 2 - Pending Action **Change Assessment Strategy:** Yes	05/29/2012 - Future surveys need to include a minimum of one question clearly related to this topic.
Program - HVACR Technology (A.A.S.) - Troubleshoot HVAC - Students will systematically troubleshoot and repair residential and light commercial HVAC equipment. **Outcome Types:** Learning **Start Date:** 01/01/2009	**Assessment Method:** Faculty will observe student in laboratory setting. **Assessment Method Category:** Observations (e.g. Clinical or Field) **Criterion for Success:** Accurate installation of HVAC components.	05/14/2012 - Spring 2012, HVAC 132 mid term lab exam average 92.9% **Classification:** Criterion Met **Action:** 1 - No Action Required	
		12/06/2011 - Fall 2011 semester, HVAC 132 mid term lab exam, average 88.9% **Classification:**	

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
Outcome Status: Active		Criterion Met **Action:** 1 - No Action Required	
		05/07/2011 - Spring semester, HVAC 132 Mid term lab exam, average 97.7% **Classification:** Criterion Met **Action:** 1 - No Action Required	
		10/20/2010 - Fall 2010 semester, HVAC 132 mid term lab exam average 91% **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Faculty will test student in classroom setting. **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score on examination.		
	Assessment Method: Alumni survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - No survey questions provide a clear basis for analysis. The best available data is identical to the information shown for service air conditioning. **Classification:** Inconclusive **Action:** 2 - Pending Action **Change Assessment Strategy:** Yes	05/29/2012 - Future surveys need to include a minimum of one question directly related to this topic.
Program - HVACR Technology (A.A.S.) - Design HVAC - Students will design residential and light commercial HVAC systems.	**Assessment Method:** Faculty will test student in classroom setting. Exam includes psychrometrics, heat transfer basics and residential load	03/01/2012 - Mid term exam 78.5 % of students scores acceptable. **Classification:** Criterion Met	

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
Outcome Types: Learning **Start Date:** 01/01/2009 **Outcome Status:** Active	calculations **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** 80% test score average	**Action:** 1 - No Action Required	
	Assessment Method: Student design projects **Assessment Method Category:** Project/Model/Invention **Criterion for Success:** Accurate and complete load calculation, equipment selection and duct design for a residential dwelling based on plans and specifications. Accurate and complete load calculation for a light commercial building. Accurate and complete hydronic design for a residential building. Success will be demonstrated by a minimum score of 40 on a scale of 50. Grading rubric based on the categories of correct values,correct procedures, completeness and on time delivery of project.	05/14/2012 - Spring Semester 2012: All projects average 42.85 **Classification:** Criterion Met **Action:** 1 - No Action Required	
		12/06/2011 - Fall Semester 2011, All projects average 45.72 **Classification:** Criterion Met **Action:** 1 - No Action Required	
		05/05/2011 - Spring 2011 semester: All projects average 42.75 **Classification:** Criterion Met **Action:** 1 - No Action Required	
		01/03/2011 - 93% acceptable proficiency 7% Marginal 0% unacceptable **Classification:** Criterion Met **Action:** 1 - No Action Required	
		12/05/2010 - Fall 2010 semester: All projects average 46.86 **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Alumni survey	05/29/2012 - Survey topic providing analysis;	

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
	Assessment Method Category: Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	Design HVAC 41.7% very well prepared, 37.5% well prepared, 18.8% fairly prepared, 2.1% fairly prepared, 0% barely prepared Survey results show 79.2% of graduates have a positive perception of their preparation for this topic. **Classification:** Criterion Met **Action:** 1 - No Action Required	

**Unit Assessment Report - Four Column

Ferris State University

Program - HVACR Engineering Technology (B.S.)

Mission Statement: HVACR provides quality education and training that emphasizes practical skills, and prepares the student to analyze, synthesize and solve problems. This is accomplished in state-of-the-art facilities with highly qualified instructors.

Advisory Board/Committee Meetings: Twice per year

Next FSU Academic Program Review: 2012-2013

Accreditation Body: N/A

College: CET

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
Program - HVACR Engineering Technology (B.S.) - Select system - Students will analyze and select commercial and industrial HVAC systems for specific applications. **Outcome Types:** Learning **Start Date:** 01/01/2009 **Outcome Status:** Active	**Assessment Method:** Faculty will analyze and score written submittal. **Assessment Method Category:** Written Product (essay, research paper, journal, newsletter, etc.) **Criterion for Success:** Appropropriate system selection with valid decision criteria.	04/13/2012 - Acceptable report **Classification:** Criterion Met **Action:** 1 - No Action Required	
		03/30/2012 - Acceptable report **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Written exam **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score.	03/16/2012 - Passing score **Classification:** Criterion Met **Action:** 1 - No Action Required	
		02/01/2012 - Passing score **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Academic program review survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of the survey respondants.	05/29/2012 - no survey questions provide a clear basis for analysis. **Classification:** Inconclusive **Action:** 2 - Pending Action	05/29/2012 - Future alumni surveys need to include a minimum of one question clearly related to this topic.

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
		Change Assessment Strategy: Yes	
Program - HVACR Engineering Technology (B.S.) - Design system - Students will design commercial and industrial HVAC systems, given design parameters, building type and geographic location. **Outcome Types:** Learning **Start Date:** 01/01/2009 **Outcome Status:** Active	**Assessment Method:** Faculty will analyze and score design project. **Assessment Method Category:** Project/Model/Invention **Criterion for Success:** Appropropriate system design according to current industry standards.	04/21/2012 - Acceptable report **Classification:** Criterion Met **Action:** 1 - No Action Required	
		02/17/2012 - Acceptable report **Classification:** Criterion Met **Action:** 1 - No Action Required	
		02/03/2012 - Acceptable report **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Written exam **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score.		
	Assessment Method: Academic program review survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - Survey topic providing analysis; Well prepared in the area of HVACR Design 60% strongly agree, 32% agree, and 4% disagree Survey results show 92% of graduates have a positive perception of their preparation for this topic. **Classification:** Criterion Met **Action:** 1 - No Action Required	

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
Program - HVACR Engineering Technology (B.S.) - Select secondary equipment - Students will select secondary equipment for specific commercial and industrial ducting and piping systems. **Outcome Types:** Learning **Start Date:** 01/01/2009 **Outcome Status:** Active	**Assessment Method:** Faculty will analyze and score equipment selection submittal. **Assessment Method Category:** Project/Model/Invention **Criterion for Success:** Appropropriate equipment selection with valid decision criteria.		
	Assessment Method: Written exam **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score.		
	Assessment Method: Alumni survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - 1st survey topic providing analysis; Well prepared in the area of equipment selection 48% strongly agree, 36% agree, and 16% neutral Survey results show 84% of graduates have a positive perception of their preparation for this topic. 2nd survey topic providing analysis; Equipment selection is an important part of your job 36% strongly agree, 28% agree, 24% neutral, 8% disagree, and 4% strongly disagree Survey results show 64% of graduates have a positive perception of the importance of this topic for their career. **Classification:** Criterion Met **Action:** 1 - No Action Required	
Program - HVACR Engineering Technology (B.S.) - Select primary equipment - Students will select primary equipment for specific commercial and industrial ducting	**Assessment Method:** Faculty will analyze and score equipment selection submittal. **Assessment Method Category:**		

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
and piping systems. **Outcome Types:** Learning **Start Date:** 01/01/2009 **Outcome Status:** Active	Project/Model/Invention **Criterion for Success:** Appropropriate equipment selection with valid decision criteria.		
	Assessment Method: Written exam **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score.	02/01/2012 - Passing score **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Alumni survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - 1st survey topic providing analysis; Well prepared in the area of equipment selection 48% strongly agree, 36% agree, and 16% neutral Survey results show 84% of graduates have a positive perception of their preparation for this topic. 2nd survey topic providing analysis; Equipment selection is an important part of your job 36% strongly agree, 28% agree, 24% neutral, 8% disagree, and 4% strongly disagree Survey results show 64% of graduates have a positive perception of the importance of this topic for their career. **Classification:** Criterion Met **Action:** 2 - Pending Action	05/29/2012 - Future surveys need to questions that clearly differentiate between primary and secondary equipment selection.
Program - HVACR Engineering Technology (B.S.) - Commission - Students will commission a commercial or industrial HVAC system. **Outcome Types:** Learning **Start Date:** 01/01/2009 **Outcome Status:**	**Assessment Method:** Faculty will analyze and score commissioning exercise in lab. **Assessment Method Category:** Performance (e.g. Music, Theatre) **Criterion for Success:** Appropropriate commissioning of HVAC system per job (lab) specifications.		

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
Active	**Assessment Method:** Written exam **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score.		
	Assessment Method: Alumni survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - 1st survey topic providing analysis; Ability to commission an HVAC system is an important part of your job 56% strongly agree, 24% agree, 12% neutral, 4% disagree, and 4% strongly disagree Survey results show 80% of graduates have a positive perception of the importance of this topic for their career. 2nd survey topic providing analysis; Well prepared to commission HVAC equipment 24% strongly agree, 56% agree, 12% neutral, 4% disagree, and 4% strongly disagree Survey results show 80% of graduates have a positive perception of their preparation for this topic. **Classification:** Criterion Met **Action:** 1 - No Action Required	
Program - HVACR Engineering Technology (B.S.) - Energy Audit - Students will perform an energy audit of an actual facility and analyze utilities for proper application; Operation and Maintenance (O & M) and Energy Conservation Measures (ECMs) for potential energy savings; and implementation feasibility using payback calculations. **Outcome Types:** Learning **Start Date:**	**Assessment Method:** Faculty will analyze and score written and visual energy audit submittal and presentation. **Assessment Method Category:** Service Project/Service Learning **Criterion for Success:** Appropropriate energy analysis based on current and acceptable industry standards. Appropriate and valid O & M and ECM recommendations based on findings and economic payback analysis.	12/08/2011 - Acceptable Energy Audit **Classification:** Criterion Met **Action:** 1 - No Action Required	
		12/08/2011 - Acceptable Energy Audit **Classification:** Criterion Met **Action:** 1 - No Action Required	
		09/29/2009 - Scores for written submittal	

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
01/01/2009 **Outcome Status:** Active		verified acceptable proficiency. Visual assesment of student presentations verified acceptable presentation skills for 95% of students. **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Written exam **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score.	12/01/2011 - Passing score **Classification:** Criterion Met **Action:** 1 - No Action Required	
		11/01/2011 - Passing score **Classification:** Criterion Met **Action:** 1 - No Action Required	
		10/04/2011 - Passing score **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Alumni survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - 1st survey topic providing analysis; Energy audits are an important part of your job 28% strongly agree, 36% agree, 28% neutral, 8% disagree, and 0% strongly disagree Survey results show 64% of graduates have a positive perception of the importance of this topic for their career. 2nd survey topic providing analysis; Well prepared to do an energy audit 28% strongly agree, 56% agree, 12% neutral, 4% disagree, and 0% strongly disagree Survey results show 84% of graduates have a positive perception of their preparation for this topic. **Classification:**	

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
		Criterion Met **Action:** 1 - No Action Required	
Program - HVACR Engineering Technology (B.S.) - HVACR Contracting Issues - Students will understand, utilize and develop estimates, specs., economic cost analysis and codes and standards. Students will also understand the key duties of Project Management. **Outcome Types:** Learning **Start Date:** 01/14/2008 **Outcome Status:** Active	**Assessment Method:** Alumi survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - 1st survey topic providing analysis; Ability to read a blue print is an important part of your job 80% strongly agree, 12% agree, 4% neutral, 0% disagree, and 4% strongly disagree Survey results show 92% of graduates have a positive perception of the importance of this topic for their career. 2nd survey topic providing analysis; Well prepared in area of blue print reading 40% strongly agree, 28% agree, 16% neutral, 16% disagree, and 0% strongly disagree Survey results show 68% of graduates have a positive perception of their preparation for this topic. 3rd survey topic providing analysis; Ability to understand job specs is an important part of your job 72% strongly agree, 16% agree, 4% neutral, 8% disagree, and 0% strongly disagree Survey results show 88% of graduates have a positive perception of the importance of this topic for their career. 4th survey topic providing analysis; Well prepared to deal with job specifications 36% strongly agree, 24% agree, 12% neutral, 20% disagree, 4% strongly disagree, and 4% not applicable Survey results show 60% of graduates have a positive perception of their preparation for this topic. **Classification:** Criterion Not Met **Action:** 2 - Pending Action	05/29/2012 - HVAC 350 Contracting Issues is a relatively new course. This course began in 2009 as a result of the 2007 academic program review survey results. The results from surveys need to be carefully observed to ensure improvement in alumni perceptions.

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
Program - HVACR Engineering Technology (B.S.) - Control - Students will program control sequences for specific commercial and industrial HVAC systems and equipment. **Outcome Types:** Learning **Start Date:** 01/01/2009 **Outcome Status:** Active	**Assessment Method:** Faculty will analyze and score control sequence submittal. **Assessment Method Category:** Project/Model/Invention **Criterion for Success:** Appropropriate and logical control sequence based on current industry standards and practices.		
	Assessment Method: Written exam **Assessment Method Category:** Test - Internally Developed - Pre/Post or Post **Criterion for Success:** Passing score.		
	Assessment Method: Alumni survey **Assessment Method Category:** Survey - Alumni (after one year) **Criterion for Success:** Positive responses from 70% or greater of survey respondants.	05/29/2012 - 1st survey topic providing analysis; Control theory is an important part of you job 72% strongly agree, 24% agree, 0% neutral, 4% disagree, and 0% strongly disagree Survey results show 96% of graduates have a positive perception of the importance of this topic for their career. 2nd survey topic providing analysis; Well prepared in the area of control theory 48% strongly agree, 48% agree, 4% neutral, 0% disagree, and 0% strongly disagree Survey results show 96% of graduates have a positive perception of their preparation for this topic. 3rd survey topic providing analysis; Control application is an important part of your job 64% strongly agree, 28% agree, 4% neutral, 4% disagree, and 0% strongly disagree Survey results show 92% of graduates have a positive perception of the importance of this topic for their career. 4th survey topic providing analysis; Well prepared in the area of control application	

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
		48% strongly agree, 36% agree, 12% neutral, 4% disagree, 0% strongly disagree Survey results show 84% of graduates have a positive perception of their preparation for this topic. **Classification:** Criterion Met **Action:** 1 - No Action Required	

HVAC Program Perspectives

July 3, 2012

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A Unique Program

As one of only two institutions in the United States offering a Bachelor of Science degree in HVACR (Heating, Ventilation, Air Conditioning and Refrigeration), the HVACR Program at Ferris is unique. It is also well regarded and valued by industry. Since its founding in the 1980's, the program has enjoyed over ninety percent placement of its graduates, many of whom receive multiple job offers well before graduation.

The educational uniqueness of the program lies largely in its balance of hands-on practice and theory. Unlike traditional engineering programs, HVACR at Ferris begins day one with hands-on, project-based applications. Theory is brought in first with regard to specific problem solving, more broadly later in the curriculum. By the fourth year our students compete very successfully with students from Milwaukee School of Engineering, Purdue, Kansas, Penn State and others in national ASHRAE system design and analysis competitions. Over the four year course of the BS degree, the curriculum moves from the specific to the general – from individual piping and wiring connections and how components work to the energy analysis of large institutional projects. This is a very strong basis for employment of graduates in positions ranging from sales to facility maintenance to systems analysis and design. Combined with the experience gained from required internships, Ferris HVACR graduates arrive ready to work.

The Needs of Industry

Demand for both AAS and BS degree graduates remains very strong. The program has an excellent national reputation, and the marketplace should be strong for years to come. Because employment opportunities come from a number of employer types, the market for four-year graduates is robust, with a breadth and diversity of career pathways. Construction, Facility management and maintenance, and industry are all showing growth, particularly the retrofitting and renewal of existing facilities and equipment.

HVAC Technology is the only program in this School from which a significant number of two-year graduates enter directly into the workforce. Per the bureau of Labor Statistics, the job outlook for these technical HVAC graduates is very strong, predicted to grow at approximately twice the national average rate between 2010 and 2020.

The Future

While the future appears bright, it would be a mistake to rest on the successes of the program. In addition to competing educational offerings from other institutions, there are curriculum-related areas that need to be considered as the program moves forward, in particular:

1. Renewable energy technology and management
2. Control systems
3. The increasing complexity of project delivery teams and the software used to model and document designs.

Each of these trends has potential curriculum implications.

Renewable Energy

Many renewable energy systems are HVAC systems, from the direct solar heating of water to wind generation of electricity, its storage and use to power building systems. As energy prices rise and states increase their targets for percentage of energy provided from renewable sources, individual buildings will also become energy producers. This trend requires graduates who understand both principles of renewable energy design and the implementation of specific systems.

Control Systems
Energy and comfort control and management systems are becoming ever more complex. Their failure is often the cause of occupant complaints in buildings. The design, installation, maintenance and troubleshooting of control systems is a growing marketplace and growing employment opportunity for our graduates.

Project delivery
There are two aspects to this trend: increasingly large, interdisciplinary project teams; and three-dimensional design modeling and facility management software (BIM – Building Information Modeling).

College is in many ways a rehearsal for life and work for students. To the extent that our graduates will be increasingly called to be members of interdisciplinary teams, the curriculum is an opportunity for learning the needs and thought processes of other disciplines in a safe environment. The programs of the School of Built Environment certainly can provide this.

BIM is rapidly taking over the process of the design of institutional facilities. Our graduates need to be conversant in BIM software and understand its profound effect on the design and project delivery process. The line is rapidly blurring between designer, constructor, manufacturer, installer and operator – projects are not sequential events with handoffs, but rather multiple simultaneous tracks of design, fabrication, installation and operation. Our graduates need to understand this and demonstrate their proficiency in BIM tools and process.

The HVACR Program at Ferris has a proud heritage. It has shown its willingness to be responsive to the needs of industry and adapt to changing times. That heritage and the willingness to adapt will serve it well in the future.