Industrial Chemistry Technology (ICT, AAS)

Report for the Academic Program Review Committee

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Program Overview

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A-Program Goals

The Ferris State University Industrial Chemistry Technology program is a lab-based associates degree. The mission and goal of the degree is largely to train capable laboratory technicians who are ready to enter the workforce. The fiftieth anniversary of the program will be celebrated in the Fall 2007, so it has had a lot of time to become an established supplier of technicians for many of the chemical companies around Michigan and the country. The history of the program has most largely been successful in Michigan, where it is well-known for producing good lab techs. ICT graduates go on to work in many companies and all sites where they produce new drugs, make plastics, or accomplish any number of the tasks that make day-to-day living possible.

At the same time, many ICT graduates go on to earn higher level degrees, be it a bachelors in chemistry at Ferris State University or somewhere else. ICT grads have gone on to Masters and PhD. programs as well. Many ICT students have done well in other Ferris programs like pharmacy school, for instance.

The chemistry courses that are specifically included in the ICT program focus on laboratory safety as well as practical, analytical and synthetic skills. The students who come to the program are generally proactive and able to think on their feet. The program, then, is built to encourage these traits and promote scientific creativity.

The educational goals of the FSU ICT degree are to train students in an academic environment to take positions in industry as chemical technicians. Many chemical technicians are trained on the job, but the academically trained chemical technician who is educated in the basic, core sciences of chemistry, physics, and the applied sciences of chemistry technology and computer science, as well as having a background in mathematics, English, the behavioral sciences, and humanities will more quickly become a valued team member. The background intended for ICT students, then, is varied and diverse. The graduates of this training program are equipped with the skills needed to successfully obtain entry-level employment in the rigorous chemical, pharmaceutical, or other related industries and to pursue further education in chemistry or other degree programs.

The FSU ICT program is well recognized for its strengths. There have been 57 graduates from the ICT program since 2001. Not only are the students excited about the classes, but the faculty recognize the validity of the program. Also, the ACS (American Chemical Society) provides certification for programs in chemistry across the nation. At the bachelor's level, they certify mainstream chemistry degrees, as well as degrees in specialty areas, such as biochemistry. Over the past few years the ACS has also been certifying some two-year programs. Currently, the Ferris ICT program is one of only a small handful of nationally certified programs, which sets our program in very select company.

The Industrial Chemistry Technology program supports and strengthens the University's mission and goal, as well as all strategic plans therein or associated with the University. The specific additions that ICT students make toward the further advancement of the unit strategic planning of the physical sciences are distinct. The program advances scientific understanding and trains students to deal with complex scientific ideas in technological (instrumental) as well as theoretical ways, and also trains students to test the strengths of the hypotheses that are generated; this is the real goal and mission statement of science in general, not to mention its mechanism. Some ICT courses are strong introductory classes in the physical sciences that anyone could take, while others are designed for the professional/technical student to excel with work.

There are two main areas in which programs similar to ICT are oriented. One is to emphasize the preparation of chemical technicians to work in quality control, research and development, or various types of industrial support laboratories. This is the distinct goal of the Ferris ICT program as it has been introduced. The other area of emphasis is in chemical process work, where technicians are less involved in the laboratory, but more involved in large scale plan operations. The ICT program does not emphasize this second area, although many grads are asked by the companies they work for to flex into such a role. Such preparatory programs with this emphasis require large engineering type facilities.

Finally, program goals are reflective of the fact that ICT grads are going more often to smaller companies and directly entering BA programs in greater numbers than ever. Ten to fifteen years ago, the bulk of the ICT grads found work at one of several large employers such as Dow, Dow-Corning, Eli-Lilly, etc. This is no longer the case. Therefore the skills that ICT student acquire are ultimately being put to use in different environments upon graduation. In Michigan, our program has long standing status. The importance of the ICT program being housed in a four year institution cannot be overemphasized. The competitive level our students thus attain is an important part of this development.

B-Program Visibility and Distinctiveness

The FSU ICT program is both visible and distinctive to employers in professional areas of the chemical industry. They know that our students are strong and reliable, and they come here to recruit them. The program is unique in the hands-on emphasis it offers and in the real-world experiences that are stressed in the classes.

The program does not fail to attract quality students. Those students who are taking upper level chemistry courses have been attracted many times over to the program. Those that are competent enough in the lab to be interested in the ICT program recognize a desire to improve the decision making skills that they possess. The chemical industry is not an attractive place for students who refuse to work hard or who do not want to learn

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how and things work. The program emphasis on safety further promotes the importance of know how things work for personal health reasons.

According to the industrial feedback that we receive, there are no really major competitors to the FSU/ ICT program in our area.

C-Program Relevance

The program is very flexible in its responses to industrial needs and trends. For instance, some feedback received suggested that viscometry be emphasized in the instrumental lab. It is now in the syllabus. When the industry is hot and the companies are looking for technicians, we invite more visitors to the campus to speak and advertise the job opportunities that they have. Currently, our state and area are in a state of flux. We are willing to shift our students to serve Michigan as the market dictates. This flexibility even extends beyond Michigan.

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The students are happy with the program. Those students that are in the program are not only excited about the classes and materials, but they recruit other students to join. They see the value of recognizing and solving a problem using critical and analytical thinking. The student feedback is taken through regular class evaluations as well as through this student survey. Also, students of the program spend a lot of time in the ICT rooms, where they interact heavily with each other as well as the program coordinator, Mr. Killian. This they do of their own accord, and if any student does have a problem with the program or a person from within the program it would be dealt with quickly and professionally.

The real forces of change for the program are based on returning students, Mr. Killian's summer work, and the ICT advisory board.

D-Program Value

Instrument holdings in the program are essential: the current state of instruments in the ICT program is of a useful but aging status. There is a strong need to put instruments on a 5 year or so term of replacement as technology advances so the training of students can be maintained at a high level.

The program, facilities, and faculty are very helpful to the University Physical Sciences department in training good students. The higher the quality of the student that the University pushes through the better the University's name recognition will be. The largest advantage is to the students enrolled, however. The program is really very good; the faculty associated with it encompass a number of the professors in the chemistry department. This is an incredible collection of teachers, and each of them is not only interested in individual student progress, but also equipped to affect it.

The employers that we hear from are very happy with the quality of our program. They come here to meet with our students and actively recruit them for positions in industry. This is one indication that they like what we do. Another is the survey used to construct the program review. The employers indicated that they want our students and that they are happy with the students that they have hired in the past. A final way to evaluate the value of the program to the employers is by keeping close ties with the industry itself, which Mr. Killian does through personal relationships and through maintaining relationships with past students.

The FSU ICT program has maintained representation with the ACS division of technicians. This body offers accreditations and funding to different groups. This is also the body that determines course requirements for technician programs. Maintaining this representation keeps a professional standard for the program as well as benefiting many groups outside of the University community.

The Ferris State University ACS chapter of student affiliates is heavily involved with the ICT program. This ACS group, with ICT support, has engaged in many different social activities to better the general community. Among these are the "SafeRide" program, adopt a highway, walk for warmth, volunteering (at a recycling center, for instance). This group also recently judged science fair projects at a local school and will be doing a science demonstration for grade school children.

In addition, Ferris State professor including as recently as last summer have been requested to be a part of National ACS activities. Pasquale Di Raddo has served on the ACS committee on technician affairs.

This group has also attained national status with a feature article about it in a 2006 issue of C&E news. This group also has national status as "green" chemistry chapter.

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Section 2:

Collection of Perceptions

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The data was collected using surveys. The current students were given theirs during class time, and the former students who are still around were just chased down and handed theirs. The chief program employers were contacted and the information was made available however the employers would like, either through the traditional or electronic mail. The employers then disseminated the information to their employees. Past ICT program reviews have had difficulty in getting responses, and so we selected this method in the hopes of changing that trend.

A-Graduate Follow Up Survey

The graduate survey was designed to gauge the level of preparedness that the ICT graduates had when entering the job market. We attempted to foresee the areas that may be commented on by gearing the questions in that direction, and we also left a few open-ended questions for the graduates to give their own interpretations. The graduates surveyed are not only recent, many responses came from graduates from 20 years ago, so their comments were reflective of the program at that time. Overall, the graduates were impressed with their level of job readiness. Their comments are included as per requirements; the names have been deleted (excepting faculty as this would damage the intent and meaning of the comment.)

We received thirty four (34) graduate responses. The strengths that were most often outlined were basic lab competence and the ability to find answers or help when needed. Communication skills, both oral and written, were often cited as the program's largest weakness.

The actual results of the graduate survey are included below:

Note:

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For gridded questions the number of responses is filled into their respective box while with the straight question and option sections the number of responses is listed behind the selection. Finally, for the open-ended questions that included blanks the responses are listed, as they were written, and in randomized order.

1) How long have you been employed in the field?

The average time was 12 years.

2) How long ago did you graduate from the ICT program?

The average time was 13 years.

3) Please rate and comment on the OVERALL quality of your preparation as an entry-level chemical technician.

- □Excellent- 14
- □Very Good- 16
- □Good- 4
- □Fair- 0
- □Poor- 0

4) Consider each item and rate them (independently of the others). Mark the rating you think best fits your feelings regarding each statement.

	Strongly Agree	Generally Agree	Neutral	Generally Disagree	Strongly Disagree
Taught me proper notebook habits	23	11			
Helped me to acquire the	21	12	1		

chemical knowledge base needed to function in an industrial setting					
Prepared me to collect experimental data	22	12			
Prepared me to interpret experimental data	13	17	4		
Prepared me to use instruments in order to perform appropriate procedures	23	10		1	
Trained me to use sound judgment in the laboratory	18	15	1		
Prepared me to communicate effectively by written and/or oral means	10	11	12	1	
Prepared me to conduct myself in an ethical and professional manner	18	13	3		
Taught me time management skills	12	12	10		

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5) Based on your work experience, identify 2 or 3 strengths of the ICT program:

I left ICT with a good knowledge of everything that I would be confronted with in the general work environment of Dow Corning. ICT prepared me for the practical applications of the laboratory procedures that I use on a day to day basis.

It's all very good! I was able to hit the ground running with very little "training" from Lilly. I have not seen this with folks from other schools. In fact the local school (ITT) here no longer has their program.

In general, the ICT program provides a platform for students to get hands on industrial lab type experience useful for providing working examples during interviewing process. Second, Prof. Killian is easy to talk to because of his down to earth, no nonsense approach. Prof. Killian builds confidence in students that typically choose ICT because other doors have closed. Third, Prof. Killian teaches students to go find the answers and that they have to know everything.

1-Instrumental Analysis
2-Promoted teamwork and collaboration
3-Safe work environment

1-The fact that we were running larger scale reactions in the ICT labs prepared me to be more comfortable with larger glassware set-ups and handling larger quantities of chemicals.
2-Mr Killian's ability to correlate what we were learning in the academic setting to real world industrial settings.

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3-The emphasis on safety in the laboratory including the use of personal protective equipment and understanding how to find and interpret chemical hazard information.

1-An incredible amount of knowledge and classes packed into a 2 year program.
2-Instructors helped you understand the theory and prepare you for industry.
3-Connectivity that the program has with individuals in industry.

A-Small Class size
B-Knowledge and enthusiasm of material by core course instructors
C-Recruitment visits

Provides students with a wide array of equipment to work on giving exposure to different technical aspects of the job. Prepares students for workplace by promoting good work habits such as timeliness and preparation.

My work now doesn't really pertain to my job now. But it does help with the lab portion of what goes on in my plant.

Hands on instrumentation work in the ICT lab. The ICT curriculum aligns well with other science and engineering curriculums at 4 year universities for continued education. Laboratory safety class has helped to identify potential hazardous activities.

There was a broad area of study, labs covered many different techniques. Teachers tried to make you think, not just learn.

I think the program really teaches the basics of notebook keeping and how to properly record data. Although every company/job has different requirements, the basics are taught well in the program. I also think that the

program really teaches a good attention to detail. Since my company went away from hiring out of college and went to hiring out of a general pool, I have noticed a huge difference in the attention of detail from the untrained employees to those that have gone through a program like ICT. I think the program also teaches one how to manage time/projects well and how to problem solve on your own. In most jobs, managers aren't going to have time to hold your hand all day long. I think the program teaches how to assess situations and how to deal with them.

Mr. Killian was great about preparing us not only in the area of chemistry, but interviewing and communication skills. The ICT program prepared me well for all the technical writing I do in my current position.

1-High emphasis on the ability to find information

Even though the job I have currently as a research technician at Dow does not employ most of the techniques I was taught in the ICT program (I currently maintain and operate high temperature vacuum ovens and fabricate ceramic materials), the most important skill I was taught was how to seek out necessary information. Whether I have to find out if something was patented before, what the volume of a sphere is (and yes I did need to use that), or the safety hazards involved with an experiment (i.e. MSDS info) the ICT program left me confident in finding that information on my own. This has given me the ability to be highly self sufficient and independent.

2-Excellent equipment preparation

Learning to use multiple pieces of laboratory equipment in the ICT program has greatly expedited my adaptation to other types of equipment. Learning not only to operate the equipment but having an understanding of how the equipment operates has given me the basic tools to expand my operational skills. While I rarely use any pieces of analytical equipment taught in ICT (NMR, FTIR, Atomic Spectroscopy, GC, etc), knowing how to operate as well as knowing the functionality of these instruments has allowed

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me to gain employment as well as to quickly size up and learn new equipment. In my five years of employment at Dow I have taken ownership of many pieces of equipment and operate various pieces such as:

High-temp vacuum furnaces	Diamond cutting saws
Polishing equipment	Optical Microscopy
SEM	TGA
X-ray diffraction	DSC
Instron testing	Sonic Modulus
Vicker's hardness testing	

1-excellent professors
2-hands-on experiences in lab
3-useful, real world experiments

All the lab experience prior to graduation is the major strength. Also the transferability of the course to further your education and become more successful in your field of work.

1-Learn to work independently, safely, and efficiently in a lab setting.
2-Excellent record keeping and notebook management.
3-Familiarity with how labs should function.
4-Safety class was excellent, how to read MSDS, etc. Use this almost everyday.

Small class size which gives you more one on one attention. Companies come to FSU to seek out ICT graduates.

Program gave broad training in preparation for industry. Program provided good hands on experience. Program builds confidence.

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Good general understanding of most instrumentation used in most laboratories and a good foundation in laboratory skills.

Good hands on experience with all instruments used in the field. Excellent time management skills. Excellent data collection and recording skills.

Overall preparation to perform as a technician, extensive hands on chemical laboratory courses.

1-Bill Killian nurturing students with unfocused abilities to produce a capable employee.
2-Expectation for an attention to details.

I would have been very well prepared for a laboratory type position, however I was hired in as production operator. Some of the skills were relevant to the job, like the lab equipment for testing viscosities and weighing procedures. The chemistry background also helped with the understanding of the products. The safety aspect was also good. Knowing how to read an MSDS and where to find certain information.

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6) Based on your work experience, please make 2 or 3 suggestions to further strengthen the program.

1-Greater emphasis on interpreting process data collected continually; Statistical Process Control.
2-Give presentations on data gathered during experiments.
3-Overview of patents; how to conduct a patent search and create a patent landscape. Understand how valuable Intellectual Property really is.

1-Build students' communication skills, this is one of the biggest problems I see on a daily basis.
2-Instruct students on how to effectively manage their time.

Multitasking (doing more with less has been a huge industry push); experimental design is huge too; hit the chemistry.

1-more statistical evaluation of data
2-more opportunity to give presentations and lead small projects

Simple quantitative/qualitative techniques. The fancy equipment is nice, but not always available.

1-Continue upgrading instrumentation and method development techniques in the analytical section of the curriculum.
2-Consider adding information/coursework around the science of reactive chemicals. Especially the techniques and understanding/interpreting test results.

1-Updated test equipment and experiments
2-Presentations and summaries of experiments conducted.

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3-Have multiple projects students can work on, rather than everyone doing the same thing. It helps to learn how from others without directly doing the work yourself.

Add more plastics/polymer info.

Create an internship program to gain work experience. Increased data presentation (group presentations, technical writing and reports)

It's been a while since I've been there but oral communication skills as well as the use of Microsoft Office tools Word, Excel, and PowerPoint should be stressed. Also, maintain or improve education on safety, health, and environmental.

Obtain current technologies and equipment. Outside speakers from industry would help.

A-More emphasis on developing interviewing skills and obtaining feedback based on interview performance.
B-Help students find their strengths within the program in order to help them give focus on these areas while interviewing as well as helping them to improve their weaknesses.

I think it would be beneficial to teach the students how to write a more technical report. While the program prepares one for notebook keeping, data collection, and data interpretation; I think it lacks in technical writing of data and reports. I would also say the same about giving a presentation. Giving a presentation in an English class or communication class is not the same as standing in front of peers and managers and trying to explain what you are working n. Maybe have each student work on a special project and give a

presentation to the Physical Sciences staff, somewhat to the presentation I had to do in my Current Topics in Biology class.

Increase technical writing course requirements. Increase training with analytical instruments interfaced to computer software. Include training on preparing and giving oral technical presentations.

1-More exposure to different types of reports

While the ICT program gave some experience in writing analytical reports, I was ill prepared to write a 20-30 page report detailing research work I had done in order to document it for others in the company. It is one thing to detail findings of a specific set of data; it is an entirely different process to document 3 months or more worth of work on a research project. While I realize every company is different and since I work in a research environment my perception of reporting now may be skewed in that direction, even being exposed (not necessarily writing) to different types of reports that are out in the industrial world would have left me more prepared than I was.

2-More exposure to aspects of technician jobs

I have worked as an industrial technician for just over 5 years now and I really have only a perception of my specific job. Working in research I perform multiple duties from pure research (devising techniques, making testing equipment, fabricating samples, etc) to performing analytical testing, maintaining equipment and ordering supplies. My job is very diverse and dynamic. However, I am under the impression that this is not the norm for a lot of technicians. I have seen some that only perform specific tasks (i.e. analytical) or have more routine duties. While I am so far happy with my choice, I feel I didn't have a full understanding of the possibilities a technician degree can offer or what other types of jobs I could expect.

I work for a traditional chemical manufacturer, but most of the growth seems to be in biotech and pharma. Maybe incorporate more into the curriculum (if not already done).

Provide more team based activities since a lot of work depends upon the team outcome not just individual contribution. More focus on the business aspect. All activities impact the financials and a better understanding of financial analysis will assist employees in understanding the financials provided to them by their team leaders.

Keep the instruments your students are working with as current as possible. Continue to focus on good basic laboratory skills and proper data collection and recording.

If the program is focused toward the chemical industry I would add some chemical processing curriculum. Include basic operations layouts, pumps, condensers, reactors, and mixing vessels.

First, consider to provide more interviews, practice. Second, provide more writing and speaking (communication) opportunities/requirements. Third, identify summer internships that could lead to hire. We are being asked more and more to find students/contractors/consultants to execute hands on experiments (Mich. Tech. U). The process needs to be streamlined within Dow Corning or relationship developed so that FSU is included.

The industry field trips were informative, add more if possible. Jobs in this field are so diverse; it would seem to be difficult to add more to the program to address specific areas. Discuss career development of techs once they are in their place of employment. Encourage furthering education and so forth.

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The addition of instrument trouble shooting would be beneficial (GC, HPLC). A technical writing class for the chemical industry. A communication class with emphasis on interpersonal communication and presentation of technical information.

One possibility for improvement would be more focus on technical writing. Although some is covered in the program it seems that in my technician role I could have used more practice. Also more work on presentations. We did one major presentation at the end of the year but I feel that in my situation I could have used more practice in this area also.

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7) What qualities or skills were expected of you upon employment that were not included in the program and that you think could reasonably have been?

Not that this applies anymore since we haven't had a Ferris grad a DCC in a few years but I was not prepared for a mfg environment. This may be where the ICT program at Ferris differs a little from Delta.

Quite honestly I'm not sure there is anything more that could have been done. Even after listing the points in question 6, I'm not sure where it could fit into such a packed program.

I feel the program gave me an adequate skill set to perform my job. I do not feel that the program was severely lacking in any area that I could think of. Although every company you work for is different, I think that I came to Dow Corning relatively well prepared for my job.

The only area I felt slightly lacking was understanding all the math supporting chromatography calibration in determining response factors in the presence of an internal standard.

None at the time of hire.

Viscometry measurement-cone plate, Brookfield bulk viscosity. Karl Fischer measure of %H2O.

1-Better organic chemistry knowledge.
2-More experience with calculations such as formulating "parts" to "percentages" to "grams needed."

There weren't any!

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Newer equipment knowledge.

I think I was well prepared upon employment.

My initial assignment did not require communication; however, some speaking, writing, and project planning would have been helpful.

1-Preparation of LC eluents (including the function of buffers).
2-More work interpreting NMR results for structure identification.

Ability to work on longer term projects, from three months to two years. Beginning with the end in mind and understanding what is scope creep.

Non-chemistry specific company related stuff. Perhaps have more speakers from target employers to discuss corporate culture type info.

Better business acumen. Did not have issue with technical side.

I mainly work with plastics and polymers. Maybe consider an extrusion or thermofarming course (non-mandatory) which would be basic enough to gain a good fundamental understanding of the types of polymer shaping.

Instrument calibration and trouble shooting, physical testing and wet chemistry methods using Karl Fischer, viscometers, and ion chromatography.

Training on preparing and giving oral technical presentations.

Overall, I was well qualified for the job I was hired to do.

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8) Please provide comments and suggestions that would help to better future graduates.

Give Killian a raise!

Include a few more business classes into the curriculum. Getting a handle on the bottom line will help them advance in their career at any business.

How about a summer intern program between year 1 and 2?

The only big problem I had was transfer of the ICT credits when I continued my education for a BS in chemistry. I had to retake many classes.

Try to gain actual field work experience prior to graduation as this will put you one step ahead of your peers.

Broaden understanding of what regulations must be followed in industry (waste management, air emissions, OSHA requirements, Industrial Hygiene requirements)-even if it just that these exist and will need to be followed, familiarity with the terminology, etc.

1-be motivated to get your work done on time (or early)
2-stay late if needed-even if you are not being paid for it-that will follow.
3-align yourself with those doing the best job (by the employer's standards) and emulate them. They are doing something right!
4-Smile often at others.
5-Adopt a friendly attitude.
6-Join Toastmasters or other communication forum early. Leaders can communicate!

A business communication class or interpersonal speaking class helps to develop skills needed to work with a variety of people. I completed both of these classes on my own through Delta College over the past year and found them to be extremely helpful in communicating in the appropriate way for business situations.

Keep relations between FSU and industry high and keep the lines of communication flowing.

1-Semester long or program long projects. Very rarely are projects in the work place completed in a week or two. This would help the students learn to pace themselves and possibly allow for more complex projects, problem solving, data interpretation, and analyzing, etc.
2-Could use more work on technical reports (findings, discoveries, etc) rather than "lab reports" and possibly presentation/communication skills by presenting work to others.

Probably the college now has revised graduation requirements that would encourage students to enroll in some diverse course work prior to graduation. The associate program at the time I graduated was a little lacking of this I thought. This is not specifically an ICT issue. Overall I found the ICT program to be very helpful especially to give a strong basic foundation to build from. Small class sizes were nice.

Add/increase training on technical writing and oral presentations.

Encourage your students not to be afraid to venture out into different areas of the company once employed to further their careers, i.e., production management, logistics, or tech. service.

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Students need to get more industry exposure. One avenue is through conferences and expo's, which often offer resume and job placement workshops. Second, students should be exposed to marketing, sales, application, development, and research roles within chemical handling industries so that they can start to envision the type of opportunities available to them. Third, identify a mentor in the field.

We did tour a few facilities, which helped to bring the practical applications of the field to light but I believe that more hands on tours would be a nice touch. So that future graduates could see some of the tasks which are being preformed at different companies.

More project type reports that will be expected in the work force, PowerPoint presentations to the entire class. For formal reports/presentations.

Utilize the ICT degree as a stepping stone. The degree offers a wide range of possibilities within the industry. The degree also sets up nicely for continued education, another admirable trait for employers.

I think Killian has done a great job with this program. Keep up the good work! He should have more field trips/job shadowing to open future graduates minds on the many job areas one can enter.

Work more on written communication and sharing of data. You can verbally communicate the results all you want and keep the best data records, but when managers want to see the information, they want to see everything in a proper and simplified report. They don't have time to read every piece of data. Same goes with presentations. Keep it simple, short, and show all the results without having to show every piece of data. Learn how to better put results in some kind of table/graph. This will keep people interested.

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I was promoted from a Lab Tech to a Material Specialist. This past year they added the role of the Api Coordinator to my responsibilities as well. It's very interesting to say the least.

I want to thank you for preparing me to be competitive with the real world. ICT is such an awesome program but I don't think it would be the same program without your leadership! I have seen others come into the role of the Lab Tech with "wanna be" ICT degrees but they haven't been able to hit the ground running quite as well as those of us from Ferris. I've also seen folks come in with years of manufacturing experience but they struggle as a tech. There is just something that your program brings that no other can.

The only think I can think of that would give others even more of an edge is to push the actual chemistry. At least for me, but I barely passed chemistry!! Once I started here and started with some of the lab work the dots started to connect for me.

The chemistry class was very intimidating for me and even the "study" sessions intimidated me. I would suggest, especially with such a small program like ICT, that you encourage the group to study their chemistry together. Maybe have some of them that have made it through mentor the rest. That would give the mentors the opportunity to work on their "public speaking" skills that they will need when they get out here. Just a suggestion.

If you ever need someone to come up and chat to the group I'd be happy to!

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B-Employer Follow Up Survey:

The employers were also sent surveys. Their perceptions of the graduates and the current program were largely favorable. The employer sample size is smaller, but that should come as no surprise as multiple technicians work at any one site. They seemed largely pleased with the program and recognized an FSU ICT student as a reasonably valuable commodity. The five employers surveyed were Michigan Dairy/Kroger Foods, Dow Chemical, Pfizer, Cytec and Dow-Corning. The data is compiled below:

The Industrial Chemistry Technology (ICT) Program at Ferris State University (FSU) is conducting a survey of employers of ICT graduates. We hope to use this information to catalog the progress of this degree and to indicate areas in which we can improve in order to continue offering an enriching, and industrially pertinent, chemical program. Please return this survey to:
Ferris State University, Physical Sciences Department, Sci 307, Big Rapids MI, 49307
Thank you for taking the time to fill this out and return it as your responses will be of great help in directing the future of this program.

1) Approximately how many employees work at this facility?

- □Less Than 50- 0
- □50-100- 0
- □101-500- 2
- □501-1000- 0
- □Over 1000- 3

2) Approximately how many chemical technicians work at this facility?

- □None- 0
- □1-25- 1
- □26-50- 1
- □51-75- 2
- □Over 100- 1

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3) What description best fits your company's primary activity? (Please select all that apply)

- □Manufacturing- 5
- □Research/Development- 2
- □Consulting- 0
- □Other, Please Specify:- 0

4) How many Ferris State University ICT graduates does your company currently have on staff?

- □1-2- 0
- □3-5- 1
- □5-10- 1
- □10 or more- 3

5) How well do you feel the FSU ICT program prepares students for employment with your company as compared to other similar programs?

- □Very Prepared- 4
- □Somewhat Prepared- 1
- □Somewhat Unprepared- 0
- □Very Unprepared- 0

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6) The following are some of the major emphases of study for the Ferris State University ICT program. Please indicate the relative importance your company places on each of them, especially as it would relate to the hiring of a recent ICT graduate for employment on your technical staff.

	Very Important	Somewhat Important	Neutral	Somewhat Unimportant	Very Unimportant
Laboratory Skills	4	1			
Chem. Calculations	2	2	1		
Report Writing	1	1	2	1	
Notebook Keeping	4		1		
Communication Skills	2	3			
Instrumental Chemistry	3	1	1		
Wet Chemistry	3	2			
Physics		1	4		
SPC	1	1.5	1.5		1
Statistics	1	3		1	

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7) All ICT graduates at Ferris are required to complete a chemical manufacturing class prior to graduation, often it is taken in their final year. This class consists of several analytical and synthetic projects, which includes setting up experiments and characterization of products. Also stressed are consistent notebook habits and report writing, as well as making a presentation to the group. To what degree does this information set ICT graduates apart from graduates of other chemical technician programs?

Can't speak to other programs, however, I think it provides insight into processes that techs can move into versus strictly performing bench assays.

Dow Corning has hired the bulk of their technicians from this program up until about 5 years ago when the economy prompted layoffs. They were desirable because of the training they received at Ferris.

These types of courses prepare the students for future, real-world experiences. It also provides for good examples for the interview process.

I think that it prepares them to take on a longer role even within an entry level position that in turn prepares them for advancement within their field.

I don't know, due to lack of knowledge of the other chemical technician programs. What I do know, however, is there is nothing I can't handle.

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8) During the last year, has your company experienced difficulty in hiring qualified chemical technicians?

□Yes-	2 (one had written "except when they come from FSU's ICT program)
□No-	1
□Do not know/Not Applicable-	2

9) Please indicate your best estimate describing the growth potential for chemical technicians at your company for the next year or next few years.

□Possible Reduction in Staff-	1
□Average/Steady-	1
□Probable Increase in Staff-	2 (one listed unknown)

10) Please use this space to provide any additional comments or suggestions you have regarding the ICT program at Ferris State University. For instance:

Are there areas that our graduates need more preparation?
Have many ICT graduates moved upwards within your company?
How interested are you in ICT graduates as potential employees?

Personally, I went on to complete a BS in chemistry. I have held different positions in QC, QA, and production. Currently, I serve as Senior Manager of Specialty Liquids, overseeing 2 buildings operations and 130 colleagues.

Statistical analysis is an ever growing part of any manufacturing process. An excellent model of this is what the foreign automakers have done to our domestic automobile industry who refused these principles in the 70's. Companies, including ours, are striving to improve processes by evaluating tests and processes with statistics. Though still a valuable tool, SPC is somewhat outdated. There are methods such as "Design of Experiment" and "Six Sigma Methodology" that are enhancing statistical controls. All major

corporations are adopting these principles to stay competitive. When it comes to a smaller company that maybe doesn't have the resources for these, an entry level person introducing them to these tools could be quite impressive. Exposure to these would be beneficial for students and do not require extensive capital.

Ferris ICT graduates come in very prepared after their schooling. Some managers in the past have even requested FSU grads specifically. We also have many grads that have been successful in the company and have gone on to complete a bachelor's degree to continue moving their careers forward. However, with the changing job market it is recommended that grads have some working experience. Students would benefit from summer jobs in the industry or by contract jobs until a full-time position can be obtained. The job market is very tough and some experience in the industry could be what pushes someone up over the competition.

4 of 7 ICT grads have moved upwards within our company.
2 of 7 are still in original positions and taking classes for higher-level degrees in chemistry or engineering.
1 of 7 left the company after about 7 years of service to complete a teaching degree.

The initial, entry-level lab tech position is fairly routine. We have found FSU ICT graduates to be competent and motivated. A basic understanding of industry initiatives (i.e., ISO, FDA, RC, 6Σ) would be beneficial.

The FSU ICT program is our first choice for recruiting laboratory technicians.

Besides the high-quality education of the ICT program, the program has been wonderful for job placement. Employers never regret hiring the FSU ICT graduate. You're a godsend Mr. Killian!

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C-Graduating student exit survey/Student program evaluation

Surveys were also given to current ICT students and those students who finished the program but have not yet finished coursework at Ferris State. The students had few comments to add, but they gave their impressions of the courses and the faculty. They also listed their other degrees, which shows the rounded personalities, as well as the diverse backgrounds, attracted to the ICT program. The courses each got good reviews, as did the faculty mentioned.

A copy of the survey with results is included below:

1) What degree are you seeking?

3 responded “Associates” with Pre-Pharmacy, Nuclear Medicine, and General Science being listed.

4 responded “Bachelors” with 6 Chemistry, 2 Biotechnology, and 2 Applied Biology

Note:

The Remainder of the survey was left as given to the
students with the number of responses following the selection.

-

2) How long have you been a student in your chosen field at Ferris State University (use answers from above)?
   - First 2 Semesters
   - 2-4 Semesters- 4
   - 4-8 Semesters- 9
   - 8 or More Semesters- 1

3) What/Who prompted your interest in the Ferris State University ICT program?
   - High School Counselor/Teacher
   - FSU Professor- 11
   - Friend(s)- 3
   - Other:- 4 (Family, Personal Interest, and Mr. Killian were listed.)

4) What are your plans or goals after completing your Ferris degree(s)?
   - Work- 5
   - Continued Education- 10 (with PhD, Masters, Physical Therapy Graduate School, Bachelors in Chemistry, Bachelors in Biology, Nuclear Medicine, and Pharmacy being listed)

   Please choose the option from the following lists that best describes the value of the subject matter covered in the following classes.
   Please select only one option and comment on any Fair or Poor ratings.

5) ICT 140: Introduction to Industrial Chemistry Technology
   - Have Not Taken- 1
   - Excellent- 9
   - Good- 3
   - Fair
   - Poor

-

6) ICT 145: Safety in the Chemical Laboratory
   - □Have Not Taken- 6
   - □Excellent- 6
   - □Good- 2
   - □Fair
   - □Poor

7) ICT 240: Chemical Calculations
   - □Have Not Taken- 3
   - □Excellent- 9
   - □Good- 1
   - □Fair- 1
   - □Poor

8) ICT 245: Chemical Manufacturing
   - □Have Not Taken- 8
   - □Excellent- 6
   - □Good
   - □Fair
   - □Poor

9) How would you describe the time management in the ICT courses you have taken?
   - □Excellent- 11
   - □Good- 3
   - □Fair
   - □Poor

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10) How would you rate the teacher's knowledge of the subject matter presented?

- □Excellent- 14
- □Good
- □Fair
- □Poor

11) How would you rate the teacher's availability, helpfulness, and courteousness?

- □Excellent- 13
- □Good- 1
- □Fair
- □Poor

12) How would you rate the facilities overall appearance and set-up?

- □Excellent- 4
- □Good- 9
- □Fair- 1
- □Poor

13) How would you rate your course lab experiences?

- □Excellent- 9
- □Good- 5
- □Fair
- □Poor

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14) How do the technical related classes conform to the program goals of preparing you to be a chemical technician?

- □Excellent- 11
- □Good- 3
- □Fair
- □Poor

15) Do you feel the classes are sequenced properly?

- □Yes- 14
- □No

-

16) Additional comments on any other matter related to assessing your education at Ferris State University; direct changes or additions (if any) to the ICT program:
(comments may also stem from non-ICT specific courses but they should in some way should relate to the ICT program)

Randomly Arranged Answers Included in the Blanks Provided Were:

Quant is ridiculous!

Great program + professor, no changes needed!!
ICT classes are well constructed. Mr. Killian has constructed a great program.

ICT is a very good program for anyone interested in science and not just chemistry majors. The lab experiences were second to none and Mr. Killian does an outstanding job preparing students for the field of industrial chemistry. From my experiences in the program I have gained valuable knowledge that will aid me in graduate school. There are no improvements that need to be made at this time.

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E-Faculty Perceptions

The final group of surveys were given out to faculty members who have a reasonably amount of dealing with ICT students. There were four surveys sent out and four returned. The comments supplied were less directed than those of the graduates and employers, but the feeling was that the program is where it needs to be.

A copy of the survey results is given below:

Note:

For gridded questions the number of responses are filled into their respective box while with the straight question and option sections the number of responses is listed behind the selection. Finally, for the open-ended questions that included blanks the responses are listed, as they were written, and in randomized order.

1) How would you rate each of the following skills of typical ICT students relative to other FSU students? Please indicate one rating for each skill.

	Much Better	Somewhat Better	About the Same	Somewhat Worse	Much Worse
Written Communication Skills	1	2	1		
Verbal Communication Skills	2	1	1		
Quantitative Skills	3		1		
Problem Solving Skills	3		1		
Work Ethic	4				

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Laboratory Skills	4				

2) How would you describe the preparation of the typical ICT student for the material of your course as compared to other FSU students?

- Much Better Prepared- 3
- Somewhat Better Prepared- 1
- About the Same- 0
- Somewhat Less Prepared- 0
- Much Less Prepared- 0

3) Please use this space to make any additional comments regarding how you would describe the ICT student's preparation and approach to your class.

-The preparation is designed to be both flexible and applicable, so the ICT students should hopefully be more prepared for any other class.

-ICT students tend to become leaders when involved in group studies in a laboratory environment.

-Less focus on numerical grade received on exams; more emphasis on understanding, long-term learning and thinking through alternatives; definitely more focused and mature

-Students preparation is generally adequate, sometimes I get well prepared and highly motivated students.

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4) The following is a simplified list of the current ICT graduation requirements. Please identify the areas that you feel are either particularly important or are not as important. If you have no opinion, feel free to leave an entry blank.

	Very Important	Somewhat Important	Neutral	Somewhat Unimportant	Very Unimportant
English 150 & 250, or equiv.	2		1		
PHYS 211 & 212	4				
Math 120	4				
CHEM 121 & 122, or equiv.	4				
CHEM 321 & 322, or equiv.	3	1			
A Social Awareness Course	1		2		
A Cultural Awareness Course	1		2		

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5) Please use this space to identify any courses or requirements that you think should be added.

-The course requirements for this program is excellent. Students come out of this program with excellent background in organic and analytical chemistry.

-I think it would be nice if FSU offered an advanced organic lab or research course 1 semester in length.

-If there were any they would be included.

-Require basics in P-Chem class. Require more exposure/lecture on green chemistry. Require more analysis of articles in the primary literature. Offer more opportunities for oral presentations.

6) Please describe the extent of your experiences with ICT students or make any other comments.

-Continue to encourage, even require, membership in our ACS club ($5/semester) or to become ACS member (~$25/year.) This is important for technicians.

-I have taught chemistry and physics labs that have included ICT students. I have taught quantitative analysis lab and instrumental analysis labs in particular.

-Students coming through this program are well rounded in terms of their knowledge in chemistry, laboratory techniques, work ethic, and in taking responsibility. Mr. Killian is an excellent role model to students, and his

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great character traits percolate very well to his students. I always find students from the ICT program very respectful, cordial, and easy to work with.

-Year in and year out they are a great group of ready professionals.

F-Advisory committee perceptions

Advisory board members and employers are one and the same. The employers surveyed were all members of the Advisory Board. Therefore, refer to the employer perceptions section to revisit their input.

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Section 3:

Program Profile

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Section 3: Program Profile

A-Profile of Students

For reference purposes, a copy of the latest Yearly Administrative Review (from December 2006) has been attached as an appendix.

1-Student Demographics.

The ICT student breakdown is often similar to the University-wide demographics for science classes. We generally have about 55% of our population being male, although this year we are closer to 63 or 64%. Historically, we have 12-15% of our students being in the minority, although this year that is at 0%. Our students are overwhelmingly registered for classes full-time andare in-state residents. The classes for our program are offered during the day, and so that is when they are taken. There are no online course offerings. Most of the courses are traditional in style, and we recruit from the traditional Ferris State University student population.

2-Quality of students

Over the last 2 years the GPA range is 2.8-3.8, with an average of 3.2. This is a reasonable grade range, and shows competent and serious student enrollment. Historically, any GPA over 2.0 is acceptable for graduation. All Ferris State University students are welcome to join the program, so there are not other methods used to measure the incoming students' potential. Many students do get financial awards. We regularly have students who earn internships from academic or industrial sources. ICT students are very active in the student chapter of the ACS. This is a program that allows for interaction with some of the campuses strongest students. It also makes available many opportunities for volunteering. These activities are chemistry related, which makes the fit even better for students engaged in earning chemical technician degrees. Several ICT students for SAACS have been presentors at regional and national SCS meetings.

3-Employability of students

ICT graduates have a great reputation for being industry ready. 100% of the ICT graduates who desire to be employed upon graduation are. There are students who decide to go on with their education instead of joining the labor force immediately. We make introducing the chemical industry a regular part of the educational process in the ICT program and accommodate the human resource departments of companies that may be interested in hiring ICT graduates. Our system works very well for those who want to take a job upon graduation.

The average starting salary for someone with an ICT degree is $32,000 to $35,000. This obviously depends on the area that the student goes to and the company that they go to work for.

There are some graduates who find part-time employment, but this is generally only on a short-term basis in times of a slumping job market, and once full-time positions are available they get picked up.

There is a lot of interest in career assistance and job placement within the program. Students come at times outside their regular meeting times to hear talks given by recruiters for different companies. The students have expressed that they are pleased with the career assistance that the program offers.

Very nearly all of our graduates are employed within the field. Those that are not have been promoted to the point that they do a slightly different job than that which they left Ferris State University trained to do. We are basing this on the graduate surveys that we received in which the average time employed in the field was very nearly that of the average time since graduation from the program.

Still many of our graduates work in Michigan . There are graduates at companies in the Grand Rapids and Zeeland area, such as Corium and Gentex. In the past, Midland/Saginaw area has always been a mainstay for the ICT program as it houses companies like DOW. At present and the foreseeable future, our grads are going to many smaller Michigan companies that rely heavily on ICT graduates as well, such as Cytec, in Kalamazoo.

Quite a few of our graduates go on for continued education. The estimated, conservative, average is about 50%. Many of the chemical companies offer a tuition reimbursement program, and so we likely have plenty of students who have gone on to further degrees, although we would not have that information at hand. The majority of the known advanced degrees-largely chemistry bachelors-have come from here, at Ferris State University.

B-Enrollment

One factor that differentiates the ICT program from most others on campus is that it attracts more students *after* they are admitted to Ferris rather than before. Many students in the program are taking courses for other degrees (such as pre-pharmacy), and some students transfer into the ICT program once they learn about the industrial opportunities. One of the anomalies of the ICT program has been that the number of graduates over a two year period can actually *exceed* the official two-year enrollment in any given fall semester. Our enrollment strategies for the ICT program typically focus more on internal recruitment than retention, because once students enroll in the program, they typically stay in it.

1-Anticipated Fall Enrollment

The anticipated fall enrollment will be similar to the past few years' enrollment numbers. The enrollment rates are steady and hover very near eight or nine. Generally, there are from two to four students who express an interest and return the following year.

The remainder of the student body is made up of students who were exposed to the program during the course of their other chemistry classes.

2-Enrollment and Credit Hour Production

Enrollment has fallen off a bit since the last program review. As there are fewer students taking similar course loads, the Credit Hour Production is also lower.

3-How many students apply annually?

Again, the application for enrollment is a little shy of ten students a year. However, it is not uncommon to have a slightly higher number of students in the higher level courses than this as some students stretch their time in the program over a greater distance. Also, there are students who transfer into the program having taken enough of the classes to move very quickly through the program.

4-How many admittances/applications?

All students that apply are admitted. The program is built on the concept of improving laboratory ability, no matter the level of improvement necessary. At this time, the program can absorb more students. Increasing opportunities in the chemical industry entice more students into the program. Currently, the climate in Michigan is very positive for chemical technicians.

5-Of those admitted, how many enroll?

Likely 75% of the students that are admitted actually enroll.

6-What are the program's enrollment goals, strategy, and efforts to maintain/increase/decrease the number of students in the program?

The recruitment done for the ICT program is almost exclusively in-house. The best, and most consistent, results have been maintained using this approach. The program coordinator visits the general and organic chemistry classes to make them aware of the ICT program. The students that are currently enrolled in ICT also suggest enrolling to other science majors who seem to enjoy lab work. If the program gets more students enrolling, the faculty would be happy. If the number of enrolling students stays consistent, the faculty would still be happy. Because this program is not one that is well known among the student population-even among chemistry majors-it is really an uphill battle every year to get new recruits.

C-Program Capacity

1-What is the appropriate program capacity?

The capacity for the ICT program is likely about 15 students in a given graduating class (that is, a total program capacity of 30 over two years). The largest reason for this is lab space. With that many students, it gets to be difficult to move around the lab very freely. Safety hazards begin to become a larger concern. The level of "realism" begins to drop off, as most industrial or research institutions will have adequate bench space for each chemist. The physical needs of each student begin to be met less with a greater enrollment. For instance, the ease of getting on an instrument decreases substantially with ever few students added.

The capacity is higher than the current enrollment. An enrollment of 12 students (in the second year of the program) would be a large class, which would be a tough number of students to attract to our program and away from their primary science-related majors.

D-Retention and Graduation

1-Give the annual attrition rate

The attrition rate for the ICT program is a loss of no more than one or two students (if any), in a given year. Once the program attracts students, they tend to stay. The program is designed to walk students through and help them along in their practical, applicable growth as technicians. As such, the program coordinator is able to spend a lot of time with each student and can give them a hands-on type of mentoring that is unlike what is found in most other programs. This allows the students to place a lot of personal stock in their own growth, partly because they answer to the instructor directly and partly because of the applicability of the work they do; it is very rewarding to learn to do things better and then go and continue to use that new skill.

2-What are the program's goals, strategies, and efforts to retain students?

As stated, the highly personal level of the program allows the program coordinator to engage each student individually. The engaged students can take what they learn and apply them directly to both this program, and to any lab components that they may have for other courses as well. Personal contact is a retention feature that ICT maintains. The engaged student is the start of the process to a successful professional.

3-Note any trends in number of degrees awarded in the program.

The number of degrees awarded is very similar to the number of enrolled students; because the attrition rate is so low the number of enrolled students is nearly the number of degrees awarded. We keep closer track of the number of degrees awarded than we do the number of enrolled students, because in the end that is what matters.

4-How many enrolled students graduate within the prescribed time?

The average time for a student to graduate from the ICT program is actually likely lower than what would be expected. Many students come into ICT having already taken

some of the basic prerequisites, such as the chemistry sequences and physics, which allows them to save a lot of time. A student who is in a related program, such as applied biology, chemistry, or pre-pharmacy can almost expect to finish the ICT courses within a single year of joining the program.

5-How many years are taken to graduate from ICT?

As stated, a student who has taken some of the background classes can very possibly come into ICT and finish the degree in a year. A student who starts out with ICT and does not have some other classes taken care of can finish the degree in 2 years. This would be a fairly heavy 2 years, and some students may prefer to stretch that over 3 to separate some of the tougher courses. Few ICT students come directly to the program, so few ICT students need to take courses like general chemistry as ICT students. Because of this, it is common to take not more than 2 years to graduate the program.

E-Access

1-Describe the program's attempts to make it accessible to students.

There are some summer courses that fit into the ICT required courses. For the most part, however, the course load is pretty traditional. The accessibility of the program comes from the fact that so many students have to take the prerequisites for the program anyway that they do not need to add too many more semester of schooling to earn the degree. Also, the program, as designed by the program coordinator, is flexible in its handling of students. ICT seeks to accommodate students however possible.

2-Discuss what effects the actions above have had on the program.

The methods described above do not directly impact enrollment as much as retention. The "personality" of the ICT program is one of its great strengths to the students. The learning environment is great because the students see each other often and work together as a group regularly. Correspondence courses would decrease the amount to which this were true.

3-How do the actions from above advance or hinder program goals?

The ICT program is built so closely around the actions described above that they are a huge advancement to the program. Many students are drawn to the program because of the real-world, work oriented learning atmosphere it has. The style of learning of the ICT program is both one of its greatest strengths and the thing that students like about it so much.

F-Curriculum

Please refer to the attached checksheet for the ICT program as you read this section.

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1-Program Requirements

The largest part of the program is **not** program-specific courses, but rather a broad preparation in traditional majors-level science and mathematics. Our students take one year of general chemistry, one year of organic chemistry, one semester of quantitative analysis, one semester of instrumental analysis, one year of general physics, and mathematics through trigonometry. To this broad preparation is added a four-course core in industrial chemistry. These classes are CHEM 140, CHEM 145, CHEM 240 and CHEM 245. Please refer to their syllabi for more information about the content of these classes.

This structure of the ICT program is attractive to students who begin other science-intensive programs and decide to make the switch, as many of their courses count towards ICT as well. For this reason, the program requirements are tailored very well towards Ferris. Our employers have also commented favorably on the preparation of our students at the end of this two-year program. In fact, this structure makes the Ferris program different from many community college two-year programs, which often include only one year of basic chemistry, with the rest of the education being technician-specific. Not only are the FSU graduates well prepared to compete for employment once they complete this program, but they are also well positioned to finish a traditional bachelor's degree in chemistry with only two full years of additional coursework.

The directed general education requirements for the ICT program include trigonometry, physics, and English. The elective credits are made up of a social awareness and a cultural enrichment elective. Trig provides a suitable math background to be able to converse in numerical fashion, which is an important feature of chemistry. Conversions and handling things like concentration are a skill set that a chemical technician need have. Physics is an important part of a scientific background because it describes in many ways how things work, and it enriches the theory behind the practice. Also, it, like the trigonometry, allows one to become accustomed to translating real world events in the language of calculations.

If the assumption is that students in this program must be ready to start a science-intensive program (such as pre-pharmacy or pre-optometry)—a reasonable assumption for this type of program—then there are no hidden prerequisites. Students who come to Ferris with one year of high school chemistry and a good background in algebra can follow the checksheet and complete the program.

2-Has the program been significantly changed since the last review?

We have not changed course names since the last review. However, we have updated the program by making changes within the courses in the curriculum. For example, we have incorporated more communication activities with the core classes. We believe this is important especially as noted by our grads of 10 years or greater. The laboratory portion of the instrumental analysis program has been upgraded with the preparation of a new laboratory manual and videos that students can watch to prepare themselves for working with the instruments. [These changes, by the way, were underwritten by a grant from the Dow Chemical Company.] Since the laboratory portion

of this class resembles junior-level work in other chemistry departments, about ten years ago we renumbered this class from the 200-level to the 300-level. (It is also required for students pursuing bachelor's degrees in chemistry and chemical education.)

One of the changes that we did make over the last five years is to re-label the ICT classes as CHEM classes. As stated earlier, CHEM 140, CHEM 145, CHEM 240 and CHEM 245 constitute the professional core of this curriculum. These classes are a valuable addition to anyone obtaining an education in chemistry (whether at the two-year or the four-year level) wishing to be prepared with a strong industrial background. We felt that we did not want to maintain an artificial distinction between courses in a two-year program and courses in a four-year program.

3-Are there any curricular or program changes currently in the review process? If so, what are they?

There are no curricular changes currently in the review process. However, faculty continue to make changes to their basic science courses that affect students in the ICT program. For example, faculty in general chemistry employ diverse teaching styles, including the use of computer-integrated technology in the lab (Dr. Prakasam) or POGIL (process-oriented guided inquiry learning) instruction in the lecture and lab (Dr. Partigianoni). In organic chemistry, some of our students are exposed to long-term mini-research projects. This feature complements the experience students receive in CHEM 245, a course that prepares students for the chemical manufacturing environment.

4-Are there plans to revise the current program within the next three to five years?

Yes. First of all, we intend to remove ISYS 105 from the curriculum, as the feedback we have received from graduates and employers indicate that the computer skills that students need are taught within the program itself (either in program courses or in the science core classes that they take). In addition, as we conduct an annual assessment of the program and its courses, we will make changes in response to the data that we collect.

G-Quality of Instruction

1-Discuss student and alumni perceptions on the quality of instruction.

This can be found above in both the graduate collection of perceptions as well as the current student collection of perceptions. There were not any complaints listed.

2-Discuss advisory board and employer perceptions.

This was done in the employer perception collection section above, and it was overwhelmingly favorable. Members of the advisory board are also contacted on a regular basis (they frequently are the employers of our students), so we have regular input on the performance of each year's graduating class.

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3-What departmental and individual efforts have been made to improve the learning environment, add and use appropriate technology, train and increase the number of undergraduate and graduate assistants, etc.?

An effort has been made to integrate computer simulations and examples into the coursework as a supplement to the instrumentation. These add depth and breadth to the currently available instrumentation in the ICT program. At the same time, the proper care and maintenance of the existing instrumentation-the physical hardware-is both time intensive and costly. Without the real instruments the simulations would lose validity and the students would lose valuable exposure. ICT also experiences a small but continued addition of instruments, which is essential to the learning environment that is in place. Therefore, adding significantly to the teaching environment or scope is difficult, although it is something that we are constantly working towards.

4-Describe the types of professional development have faculty participated in, in efforts to enhance the learning environment?

ACS (American Chemical Society) sponsored technician workshops, both national and local have been attended, by Prof. Di Raddo, Killian and Frank. Prof. Killian and Frank have been invited to present papers and serve on discussion panels on issues related to the education of technicians at national meetings (most recently in Summer 2006). Prof. Di Raddo is currently a member of the national board of Chemical Technicians of the ACS; he brings back information from national meetings to keep us apprised of recent developments in the field.

5-What efforts have been made to increase the interaction of students with faculty and peers?

ICT students are heavily involved in the on-campus ACS chapter of student affiliates. Emmanuela Ohaeri, an ICT graduate, for example, has served as president of the club. Also guest lecturers, ICT students speak, local ACS on campus speakers are a regular part of the group.

6/7-Discuss the extent to which current research and practice regarding inclusive pedagogy and curriculum infuse teaching and learning in this program, and what effects have these actions had on the learning in the program.

ICT has always been heavily student driven. There is a strong focus on student led activities, including meetings and presentations. The responsibility of many of the laboratory experiences, such as data sharing, notebook collection, project cooperation and completion, and the maintenance of a professional work area have always been essential parts of the ICT program and philosophy.

Other comments about the broad science portion of the program (including general and organic chemistry) have been made above.

H-Composition and Quality of Faculty

Program faculty (Bill Killian). The four key courses in the ICT program (CHEM 140, CHEM 145, CHEM 240 and CHEM 245) are all taught by Prof. Killian. He brings a unique background to this program. Not only does he have a degree in organic chemistry, but he also has worked in the chemical industry, thus developing an expertise with a broad range of instrumentation. His instruction has been consistently rated highly by students. Please refer to the attached vita for more information about Prof. Killian's experience. Prof. Killian is currently a tenured full professor in the department.

Other chemistry faculty in the Physical Sciences Department are active participants in educational seminars. As a result, they have brought chemical learning strategies to campus and exposed ICT students to these new methods.

Workload. Bill Killian teaches a full workload in the department, which roughly translates to fourteen-to-sixteen contact hours in lecture and laboratory combined. Prof. Killian has 0.25 FTE release time during the Fall and Spring Semesters; his duties are to coordinate the ICT program. In addition, Bill usually accepts a lecture or laboratory overload assignment each semester. He does this willingly, because he wants to teach some of the general chemistry courses in order to education and recruit students for the program.

Recruitment. Not applicable, since there are no plans to expand or replace the ICT faculty member.

Orientation. Not applicable.

Reward structure The ICT coordinator has been eligible for promotion and has taken advantage of that process. He also has access to departmental faculty development funds, and has used them for attendance at meetings. At this time, neither off-campus incentive funds nor recruiting new faculty an issue for this program.

Graduate instruction. Not applicable.

Non-tenure-track and adjunct faculty Over the last five years, all of the program-specific courses (CHEM 140, CHEM 145, CHEM 240 and CHEM 245) have been taught by Prof. Killian, a tenured full professor. Therefore, 0% of this instruction has been provided by non-tenure-track faculty. However, in the chemistry side of the Physical Sciences Department, the following non-tenure track faculty have taught one or more of the lectures for basic science classes in the program over the past year: Tracy Kerr, Gary Hiel, Francis Burns and James Weaver. Typically these faculty teach in multi-section courses. In particular, one of our non-tenure-track faculty members, James Weaver, is a graduate of the ICT program and can provide students in our basic science classes with a program perspective. In addition, Gary Hiel brings a wealth of experience in the chemical industry to his teaching. In the case of this program, the skills of our non-tenure-track faculty have been a welcome addition.

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I-Service to Nonmajors

To some extent, CHEM 140 serves as an introduction to the program. Students who are not yet majors may try this course to see if ICT would be an appropriate fit. The entire program also serves an increasing number of students in the Chemistry BA program—particularly those students who would like to add industrial experience and background to their resumés before they graduate. In fact, our CHEM BA graduates who start with a AAS degree in ICT have far more hands-on industrial-level experience than most chemistry graduates from other liberal arts colleges or universities. This is simply not part of the traditional training of most chemists—who tend to learn "on the job" what it's like to work in an industry.

In addition, the program provides some level of community service. Occasionally the department is requested to determine the composition of a substance or provide some level of testing for a local company. If our students have the expertise to do so, these projects have been incorporated into the training of the ICT students.

J-Degree Cost and Productivity

There is no easy way to measure program productivity, because (as already mentioned) there are so few courses in the program that serve only ICT students. The four main program courses in the program (CHEM 140, CHEM 145, CHEM 240, and CHEM 245) tend to have enrollments that come close to matching the number of graduates in a particular year. In terms of departmental productivity, these are some of the lowest enrolled and least productive courses in the department. However students take far more credit hours in courses such as CHEM 121, CHEM 122, CHEM 321, CHEM 322, PHYS 211 and PHYS 212. These are some of the most productive courses on the entire campus, let alone the Department of Physical Sciences. In the middle, students take courses such as CHEM 231 and CHEM 317. These classes have moderate enrollments (one or two full lab sections), because students from other programs also take these classes. However, even if ICT students weren't enrolled in these classes, these course would be required to run anyway because they are requirements (not options) for programs such as biotechnology, chemistry (BA) and chemistry education.

On an overall basis, the ICT program has historically been in the top 25% of the least expensive laboratory-based programs on campus. At first, this seems surprising, because the program has not had a large enrollment. However, the program coordinator has been cognizant of this fact and has designed a program that takes advantage of a the more fully subscribed and productive courses. By providing students what they need programmatically in a minimized set of program-specific coursework, FSU has been able to keep the program cost at a reasonable level.

K-Assessment and Evaluation

Please refer to the latest Yearly Administrative Review for details regarding this section.

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1. The program learning outcomes are listed in the YAR report. These have remained standard for the program over the last five years, and they are not course-specific, but instead represent skills that students develop across the full spectrum of courses in the program.

   While the YAR refers mostly to on-campus (in-class) assessment measures, the program coordinator also obtains regular feedback from employers. When an ICT employer comes to campus, the program coordinator usually has a personal conversation before the employer leaves.

2. Refer to the YAR report (particularly section II d and e) for more information.

   Please note that we are evaluating our students on learning outcomes that are considered important by our employers. In fact, we are encouraged to do this by the American Chemical Society. Most two-year programs in chemical technology are in regions with a specific type of chemical-related industry: general chemical manufacturing, oil, pharmaceutical, paint, etc. We need to make sure that our students develop the skills for the employers seeking our graduates.

   However, also note from the report that in terms of national benchmarks, our department has been using American Chemical Society examinations as final exams in our general chemistry classes. Students taking these exams, as a whole, have a performance that exceeds the 50th percentile. We interpret this as an indicator that our students can perform at a level at least comparable (if not slightly better than) other students nationwide in similar classes.

3. With regard to the rigor of the program, note the comment in the previous paragraph. In terms of general chemistry, the standardized ACS examination for general chemistry suggests above average achievement on the part of Ferris students.

   In terms of the more informal employer feedback, we had an indication that the research based laboratories in CHEM 322 (organic chemistry) have made a difference. During the first two years that we employed such a strategy in about half of our organic chemistry labs, employers (voluntarily) remarked that our students showed an unusually mature ability to describe choices and applications of relevant instrumentation. This is one form of validation of the statistical information kept by our organic chemistry professors.

4. Section II e of last year's YAR describes how we intend to use assessment information in the near future. Our primary goal in assessment is to collect and use the data for program change and improvement.

L-Administrative Effectiveness

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1. The program coordinator has release time (0.25 FTE per semester) to carry out many of the local administrative tasks associated with the program, including program assessment, recruitment, advising, and keeping in touch with industry. The department head provides additional support. In the department office, either the secretary or her student workers have been able to provide clerical assistance. In addition, the department has a scientifically-trained laboratory technician, who provides (together with her staff) a significant amount of support for the laboratory portion of the program. This support is clearly adequate to assist the coordinator in meeting the needs of the students.

2. The program is efficient, especially in its minimization of program specific courses. Because most of the courses in the program are multi-section, multi-program courses, students not only have ease of transfer into the program, but they also can complete the program in a variety of ways. For example, any student who has followed the checksheet for the pre-pharmacy program for the entire freshman year will be able to transfer to the ICT program and *finish its requirements* in just one more year. This, in fact, has been one of the biggest "selling points" for the program.

3. Classes have been arranged in cooperation with the department head and program coordinator. CHEM 140, CHEM 145 and CHEM 240 are scheduled in traditional time slots that allow students to take other general science and math classes throughout the day. Because few students follow the checksheet in a step-by-step fashion, it is more important to have flexibility in student scheduling than providing a lockstep cohort approach.

   One of our courses (CHEM 245) is meant to give students a sample of the chemical manufacturing environment. The coordinator maintains an open-laboratory approach to this course so that students have flexibility in how they complete their work.

4. Students can complete this program in a timely fashion (see above). Some of the lower-enrolled courses are offered only once a year, so the typical "warnings" apply: as long as students achieve the grades they need for course progression, then can remain on track for graduation within a two-year time period. Because the coordinator serves as the sole ICT advisor—and because he teaches at least two chemical technology courses each semester—all of the students have ready access to their advisor. This helps students keep in touch with the information they need to complete the program.

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Section 4:

Facilities and Equipment

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Section 4: Facilities and equipment

A-Instructional Environment

The current classrooms are adequate. The style of the primary professor, Mr. Killian, is such that the students are actively engaged without elaborate tools and methods. The lab space is also adequate as the students are crisp and professional in the way that they move throughout the labs, they accommodate each other well. The technology in the lab is adequate, although it is likely the least adequate of the three. Aging equipment is an issue. As instruments age, replacement parts are no longer available and students expertise on new technology lags behind. Our dean is aware of the aging nature of our equipment, and he has been supportive of our needs for replacement. New instruments are always nice, and there are instrumental types that are not represented at all, such as mass spec. However, enough of the machines around are in working condition such that the basics, as well as selected special depth, can be taught. Computer access and library resources to ACS journals on-line are important to the program and have been addressed.

B – Computer Access and Availability

1. Students have 8 – 5 access to the main ICT lab/study room (SCI 309), including access to the computers in the workroom area. They can go to the internet on these computers; they also can utilize chemistry software, including chemistry modeling software. For preparation of reports they frequently utilize Microsoft Word and Excel; for presentations, they may use PowerPoint. Perhaps the most important use of computers is with the use of instruments. Modern instrumentation in chemistry is software driven, so students have access to large libraries of IR (infrared) spectra, for example, through this computer-instrumentation interface.

2. Student use of these computers has been described above.

3. At this point, we would identify an upgrade of aging instrumentation (including computer-driven instrumentation) as a higher priority than stand-alone computers.

4. Most of our computer needs are addressed through the computer replacement plan of our computing consortium. When we need extra computers, they have been helpful in providing us with older office computers that are perfectly fine for working with our instrumentation.

5. Students have access to the internet in SCI 309. While students use webCT in some of their courses, this is not a major program concern at this time.

   The department has explored the possibility of providing the junior/senior level portion of the chemistry BA degree off campus to students who have completed a

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two-year degree in chemical technology. (See the YAR report in the appendix.) If these plans come to fruition, then the expanded use of computing facilities will become an issue. This, however, is more a concern of the chemistry BA program than the ICT program itself.

6. Computing resources are adequate for the program. In fact, sometimes our biggest problem is the continual "upgrades" to our computers or system software. For example, when the faculty computer was replaced in the coordinator's office, his molecular modeling program could no longer run; an expensive upgrade to the program had to be purchased. Likewise, many of our expensive instruments are used for a fifteen-to-twenty year lifespan. The supporting software often costs half the price of the instrument itself. We often need to keep older computers and older system software in order to protect our expensive investment.

C – Other Instructional Technology

1. As described in Section A, for this program the major piece of instructional technology is instrumentation. During the late 1980's and early 1990's (when the current coordinator was first on campus), the program undertook a major expansion of its instrumentation holdings. After this time, our graduates and industrial board members have described our equipment as clearly better than adequate. Prior to this expansion, this had been a major concern of the program. The equipment that the students use is not just for the program classes. For example, the instrumental analysis class (CHEM 317) is perhaps the class in which students learn the greatest amount of modern techniques. Therefore, these instruments are not exclusively "ICT" instruments, as they are also used by students in chemistry BA and chemistry education programs.

2. Students use of our technology has been described in the previous paragraph. In the Physical Sciences Department, the equipment/instruments are typically housed in the room where they are most highly used. Faculty members understand that an instrument is not "owned" by a particular courses, and they share instruments so that multiple uses are made of our expensive investment. Because students in ICT are enrolled in a multidisciplinary program (insofar as all of the areas of chemistry are covered), when students take the manufacturing course (CHEM 245) they frequently have to use multiple labs to complete their work. This is not necessarily a drawback, because in industry workers may do their preparation in one area and conduct their analyses in another. Learning how to plan a workflow is an important part of students' professional preparation.

3. The resources are adequate but aging. Our highest priority is the replacement of some of the instrumentation we purchased more than fifteen years ago. Some of these instruments are no longer supported by the companies through which we purchased them, and in some cases the costs of repair are greater than the amount we should reasonably invest in an aging instrument.

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4. Equipment and instrumentation needs are regularly featured in the department's annual planning documents, and these needs are reflected in the plans of the college. The department regularly updates its internal list of equipment needs, including new equipment and replacement equipment. We usually think of equipment needs on a department-wide basis, because (as explained already) the equipment used by students in the ICT program is not necessarily housed in the ICT labs themselves.

5. Additional instructional technology is not a major issue at this time.

D – Library Resources

1. We have good support for the program through FLITE. Within the last five years, FLITE obtained on-line versions of all the major journals of the American Chemical Society. This was done through a consortium arrangement with other Michigan universities. Our students have access to a wealth of information right here on campus that far exceeds what they could access more than five years ago.

2. Rick Bearden, our liaison librarian, has a degree in chemistry himself. He very much understands our needs and is responsive to them. In fact, our new ICT students have a session with him every September in which he instructs them on the FLITE resources that are available and how they can be accessed.

3. We have been well-served by FLITE.

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Section 5:

Conclusion

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Section 5: Conclusion

A-Relationship to FSU Mission

As is clearly indicated throughout Section 1, no program more clearly aligns itself with the institutional mission of FSU than the ICT program. The complete preparation of skilled workers becoming quickly available to serve industry in Michigan, and the US at large, is the heart of the program. The skills required to succeed in industry and the overall laboratory preparation remain central to the program and remain the reason for Fortune 500 companies hiring the graduates.

B-Program Visibility and Distinctiveness

Section 1 also covers these facts about the ICT program; the ICT program remains one of a small select group the American Chemical Society (ACS) has nationally approved for technician education and the fact that the graduate work at some of the top companies in the Midwest (see recent graduate list, attached) has kept ICT visibility very high in the appropriate circles.

C-Program Value

Program Value can be evaluated in multi-faceted fashion. The program has kept many students at Ferris that otherwise may well have transferred. The number of grads who have the ICT degree, along with another Ferris degree, continues to climb on a percentage basis; this year it is about 60%. These people recognize the ICT degree will benefit them in the workplace as an addition to their other academic credentials.

As noted in Section 4, the value to the state of Michigan and its skilled labor workforce as the predicted need for technicians rises is of paramount importance.

D-Enrollment

A total of over 231 have graduated from the program in the last 19 years. The five year average of about 8-10 graduates per year remains among the highest of the programs that the ACS receives reports on (see again the most recent list of new graduates).

E-Characteristics, Quality, and Employability of Students

The students in the program are a diverse group. One characteristic that they all have in common, though, is that they enjoy working in the laboratory. During their two years on campus, they complete the same basic science courses that a four-year chemistry major would complete at any other university. However, the variety of math and science courses at Ferris makes it possible for student to arrive underprepared in mathematics and still complete the program in two years and a summer. The program also attracts some transfer students from other two- and four-year institutions who wish to enter this very focused program of study. Importantly, the program attracts many FSU students with a

general interest in science and lab work but no specific program or, in conjunction, with another FSU program.

F-Quality of Curriculum and Instruction

Faculty members in the Department of Physical Sciences provide most of the instruction in the ICT program. The greatest percentage of the credit hours is in chemistry, physics, and industrial chemistry courses. One faculty member of the department, William Killian, serves as the program coordinator. Since the most time intensive industrial chemistry courses are taught during the winter term, he usually teaches a large general chemistry course in the fall to balance his load. However, there are times when other professors within the department have shared responsibility for some of the professional ICT courses. This has been a benefic for the department as a whole, as more faculty gain a better appreciation for the overall program, as well as exposing students to more than one point of view during their professional experience.

G-Composition and Quality of Faculty

The most important feature of the faculty in the Physical Sciences Department in regard to ICT is their expertise in the areas of importance for ICT students. Obviously, the performance of ICT grads in industry are a direct reflection of the faculty's instruction to these students. In addition, faculty like Dr. Di Raddo, and Dr. Frank go the extra mile to reach students out of class, and to keep the program current by attending seminars and being a part of the ACS on a national and local level.

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Placement of Recent ICT Graduates

Last Name	First Name	Post-ICT Placement
Acshatz	Patrick	Denso Manufacturing
Beebe	Trisha	Leprino
Birk	Matthew	Ice Mountain
Bordeaux	Abigail	EMU Chemistry BA
Borsellino	Chris	Ford Motors
Bracey	Lashonda	Pharmacia
Bretl	Chris	FSU Biotechnology
Bujouves	Nick	FSU Chemistry BA
Clementshaw	Andrew	Ice Mountain
Colaluca	Michael	Oakland U Chemistry BS
Colclasure	Jesse	FSU Plastics
Crawford	Eric	Pfizer
DiMaria	Caroline	TriMatrix Labs
Elam	Tara	FSU Pharmacy School
Ellis	Rob	Dean Foods
Gast	Jeff	FSU Chemistry BA
Geiner	Paul	Pfizer
Gladden	Eric	Cytec
Halimeh	Ola	FSU Chemistry BA
Hamilton	Mike	FSU Applied Biology BA
Irons	Jenn	FSU Education
Kanouse	Lucas	
Kuehnl	Claudine	Cytek
Littich	Ryan	FSU Chemistry BA
Maynor	Tim	FSU Business BA
Mazur	Melanie	FSU Chemistry BA
McCartney	Therese	ASU Chemistry BA
Minser	Tony	Corium International (Grand Rapids)
Neumann	Ben	Family Business
Ohaeri	Emmanuela	FSU Chemistry BA
Osterland	Ray	FSU Applied Biology
Palumbo	Brian	MSU Chemical Engineering BS
Patel	Komal	FSU Biotech BS
Pratt	Todd	Sparta Foundry
Richards	Aaron	FSU Chemistry BA
Ruefer	Matt	Cytec
Slack	Steven	Perrigo
Stephenson	Mike	GVSU Chemistry BS
Tadajewski	Amy	Madonna U Chemistry BA
Templin	Kelly	Morton Salt
Theiste	Eric	FSU Chemistry BA
Tomczyk	Amy	Pfizer
Tusek	Renee	Pfizer
Valuch	Nicole	Corium International
Vigne	Rob	FSU Medical Technology
Zondlak	Adam	Detroit Testing Lab

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Appendix A:

Checksheet and Syllabi

Appendix B:

Yearly Administrative Review (Dec 2006)

Appendix C:

Resume for Bill Killian

ASSOCIATE IN APPLIED SCIENCE IN
INDUSTRIAL CHEMISTRY TECHNOLOGY

FERRIS STATE UNIVERSITY

PROGRAM COORDINATOR: MR. BILL KILLIAN

OFFICE: ASC 3093 PHONE: (231) 591-2590 E-MAIL: killianb@ferris.edu

Admission requirements: First year student admission is open to high school graduates (or equivalent) who demonstrate appropriate academic preparedness, maturity and seriousness of purpose. High school courses and grade point average, ACT composite score, and ACT Mathematics and Reading sub scores will be considered in the admission and course placement process. Transfer students must have at least 12 credits at the time of application with a minimum 2.0 overall GPA including an English and mathematics course or they will be considered as first year students.

Graduation Requirements:

1. Minimum 2.0 cumulative grade average in all course work
2. 63 minimum credits including general education requirements
3. Residency requirement: 15 minimum FSU semester credits

Program requirements: for students entering Industrial Chemistry Fall Semester 2006

COURSE		COURSE TITLE – FOR PREREQUISITES NOT INDICATED, SEE FSU CATALOG COURSE DESCRIPTIONS		FSU S.H.	GRADE
MAJOR					
CHEM	121	General Chemistry 1	(MATH 115 AND prior high school CHEM)	5	
CHEM	122	General Chemistry 2	(CHEM 121)	5	
CHEM	321	Organic Chemistry 1	(CHEM 122)	5	
CHEM	322	Organic Chemistry 2	(CHEM 321)	5	
CHEM	231	Quantitative Analysis	(CHEM 122)	4	
CHEM	317	Instrumental Analysis	(CHEM 122 and CHEM 231)	3	
CHEM	140	Orientation to Industrial Chemistry Technology	(co = CHEM 121)	2	
CHEM	145	Safety and the Chemical Laboratory	(CHEM 121)	2	
CHEM	240	Industrial Chemical Calculations	(CHEM 140 And co- req. CHEM 321)	2	
CHEM	245	Chem Manufacturing and Analysis	(CHEM 231 and CHEM 321)	4	
MATH	120	Trigonometry	(MATH 115 or by placement)	3	
PHYS	211	Introductory Physics 1	(Math 120 with C- or higher grade)	4	
PHYS	212	Introductory Physics 2	(PHYS 211)	4	
ISYS	105	Microcomputer Applications		3	
ENGL	150	English 1	(by placement)	3	
ENGL	250	English 2	(ENGL 150)	3	
		SOCIAL AWARENESS ELECTIVE		3	
		CULTURAL ENRICHMENT ELECTIVE		3	

GENERAL EDUCATION REQUIREMENTS

Courses which qualify in the Scientific Understanding (Z), Cultural Enrichment (C) and Social Awareness (S) categories are delineated in the General Education section of the FSU electronic catalog:
http://www.ferris.edu/htmls/academics/gened/courses.html

I. GENERAL EDUCATION REQUIREMENTS

A. COMMUNICATION COMPETENCE 6 Sem Credits

Course	Grade	Credits
ENGL 150 - English 1		3
ENGL 250 - English 2		3
	TOTAL	

B. SCIENTIFIC UNDERSTANDING 3 Sem Credits

This category requirement is satisfied in the program requirements area.

C. QUANTITATIVE SKILLS

MATH 120 is required for Industrial Chemistry Technology.

D. CULTURAL ENRICHMENT 3 Sem Credits

Only approved "C" courses may count toward this category.
Requirements: maximum 3 credit hours of music and/or theater activities may apply.

Course	Grade	Credits
	TOTAL	

E. SOCIAL AWARENESS 3 Sem Credits

Only approved "S" courses may count toward this category.

Course	Grade	Credits
	TOTAL	

SAMPLE COURSE SEQUENCE: The following chart depicts one method to begin the course work requirements. In order to complete this program in a four year plan, students must average 16-17 credit hours per semester. Students MUST consult their faculty advisor to develop a course sequence plan appropriate to their academic development and educational plans.

First Year		**Second Year**	
Fall Semester		**Fall Semester**	
ENGL 150 English 1	3	CHEM 321 Organic Chemistry 1	5
CHEM 121 General Chemistry 1	5	CHEM 231 Quantitative Analysis	4
MATH by placement	3	PHYS 212 Introductory Physics 2	4
CHEM140 Orientation to Industrial Chemistry	2	CHEM240 Industrial Chemistry Calculations	2
Cultural Enrichment elective	3-4	Total	**15**
Total	**16-17**		
Winter Semester		**Winter Semester**	
CHEM 122 General Chemistry 2	5	CHEM 322 Organic Chemistry 2	5
PHYS 211 Introductory Physics 1	4	CHEM 317 Instrumental Analysis	3
ISIS 105 Microcomputer Applications	3	ENGL 250 English 2	3
CHEM145 Safety & the Chemical Lab	2	CHEM245 Chem. Mfg. and Analysis	4
Social Awareness elective	3	Total	**15**
Total	**17**		

NOTICE REGARDING WITHDRAWAL, RE-ADMISSION AND INTERRUPTION OF STUDIES

Students who return to the university after an interrupted enrollment (not including summer semester) must normally meet the requirements of the curriculum which are in effect at the time of their return, not the requirements which were in effect when they were originally admitted.

BILL KILLIAN

CHEM 140
ORIENTATION TO INDUSTRIAL CHEMICAL TECHNOLOGY
2 SEMESTER CREDITS

AUGUST 2006

Lec: TR 9-9:50 am
Loc: SCI-336
Office Hours: MRF 11-12 T 10-12

Office SCI-307
Phone: x2590

FALL 2006 SEMESTER

Textbook: None required

Week and Assignment	*Topic*
8/28	*Role of Chemical Technologist*
9/4	*Chemical Literature*
9/11	*Use of the Library*
9/18	*Computer Searching*
9/25	*Physical/Chemical Properties*
10/2 *Exam I*	*Data/Graphing*
10/9	*Introduction to Industrial Chemistry*
10/16	*Diagrams and Drawings*
10/23	*Inorganic Process Chemistry*
10/30	*Organic Chemical Processes*
11/6 *Exam II*	*Pollution Prevention in Industry*
11/13	*Notebook and Patents*
11/20	*Specifications*
11/27 *Paper Due*	*Good Lab Practice*
12/04	*Personal Protective Equipment*

12/11 Finals Week

"Knowledge is of two kinds: we know a subject ourselves, or we know where we can find information in it."

Dr. Samuel Johnson (1709-1784)

IMPORTANT CONSIDERATION:

Your attendance in lecture and lab in MANDATORY. You are expected to regularly attend and exhibit a good professional attitude in class and in lab.

Requirements		***Grading Scale/Total Points***	
Journal Work	*120*	*A >506*	*C+>424*
Exams	*300*	*A->495*	*C >401*
Paper on a chemical compound	*100*	*B+>478*	*C->369*
Attendance	*30*	*B >462*	*D >330*
		B->440	*E <330*

CHEM 145

Chemical Lab Safety

2 Credits

Mr. Bill Killian
T, R 9:00 am
SCI-336

January 9, 2006
Winter Semester 2006

Textbook: **"Chemistry of Hazardous Materials," Eugene Meyer 4th Edition**

Office Hours: **M, T 8:00; W 9-11:00**

WEEK OF	TOPIC	ASSIGNMENT	ACTIVITY
1/9	General Safety & Lab Labels	M1	
1/16	MSDS Sheets	M1	
1/23	Physical Properties as Related to Hazards	M2	
1/30	Compressed Gases & Liquids	M2	
2/6	Flammables	M3	Unit Test 1
2/13	Hazardous Matter	M4	
2/20	Chemical Reactivity & Combustion	M5	
2/27	Chemistry of Some Common Elements	M7	
3/6	**Spring Break**		
3/13	Corrosives	M8	Unit Test 2
3/20	Water Sensitive Materials	M9	
3/27	Toxilogical Levels	M10	
4/3	Redox Hazards	M11	
4/10	Organic Hazards	M12 & 13	Safety File Due
4/17	Explosives	M14	Unit Test 3
4/24	Radiation	M15	
5/1	**Final Exam**		

Requirements

Final Exam	100
Unit Tests	225
Homework/Attendance	125
Safety File	50

Grading

>92%	A
90-92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
73-76	C
70-72	C-

Other Considerations:

1. Homework assignments will be assigned weekly and will be due 1 week after the assignment has been given! Please do not be late! Keep all homework in a notebook for study.

2. The safety file is a compilation of at least 10 articles, preferable newspaper, on matters of safety. Details will be provided during class.

3. The course continues CHEM 140 Series as a central part of our curriculum.

4. Be able to demonstrate you are spending time reading the chemical literature.

5. Attendance is required.

Course Objectives:

1. To continue the development of the attitude and background a successful technologist displays.

2. To become keenly aware of the chemical laboratory from a safety standpoint, through not only recognition, but also appropriate calculations.

3. To be able to make sound judgments from a safety standpoint on what types of materials are not compatible.

4. To be able to safely work with hazardous materials, limit one's overall exposure to them, and correctly dispose of such materials.

5. To realize and begin to think about the large safety and health problems facing laboratories and the world.

"I do not know what I may appear to the world;
but to myself I seem to have been only like a boy
playing on the seashore, and diverting myself in
now and then finding a smoother pebble or a prettier
shell than ordinary, whilst the great ocean of truth
lay all undiscovered before me."

Sir Isaac Newton (1642-1727)

BILL KILLIAN **CHEM 240** **AUGUST 2006**

INDUSTRIAL CHEMICAL CALCULATIONS
2 SEMESTER CREDITS

Lec: MW 9-9:50 am *Office SCI-307*
Loc: SCI-336 *Phone: x2590*
Office Hours: MRF 11-12 T 10-12

FALL 2006 SEMESTER

Textbook: "Chemical Problem Solving" Nakon
"SPC Simplified Practical Steps to Quality" Amsden

Week	Assignment/Activity	Topic and Assignment
8/28	Introduction, Measurements and Nomenclature	N
9/4	Concentration	N
9/11	Practical and Advanced Problems	Max Quiz #1
9/18	Stoichiometry	N
9/25	Practical and Advanced Problems	N
10/2	Gases	Max Quiz #2
10/9	Redox	Handout
10/16	Statistics for Analytical Chemists	N Quiz #1
10/23	Practical and Advanced Problems	N
10/30	Introduction to Statistical Process Control	A Quiz #2
11/6	Graphs	A
11/13	Control Charts	A
11/20	Practical and Advanced Problems	A Max Quiz #3
11/27	Basic Chemical Engineering Problems	Handout
12/04	Basic Chemical Engineering Problems	Handout
12/11	Finals Week	Quiz #3

IMPORTANT CONSIDERATION:

Your attendance in lecture and lab in MANDATORY. You are expected to regularly attend and exhibit a good professional attitude in class and in lab.

Requirements		***Grading***	
MAX Quizzes	*3 x 75*	*>92%*	*A*
QUIZZES	*3 x 50*	*90-92%*	*A-*
		87-89%	*B+*
		83-86%	*B*
	375 points	*80-82%*	*B-*
		77-79%	*C+*
		73-76%	*C*
		70-72%	*C-*
		<70%	*D*

CHEM 245

Chemical Manufacture & Applied Analysis

4 Credits Spring Semester 2007

Mr. Killian

Lecture: M 9-9:50am SCI-336 January 08, 2007

Lab: M all day (10 am -5:50 pm)

Textbook: "Analytical Chemistry for Technicians," 3rd edition by: John Kenkel

WEEK OF:	TOPIC & LAB ASSIGNMENT
1/08	Introduction to Methodology: Physical Methods
1/15	Gravimetric Analysis: Gravimetric Iron
1/22	Titrimetrics: ASTM Methods
1/29	Redox Analysis: Pickle Liqour Analysis
2/05	Complexometric Titrations: Water Hardness
2/12	Quantitive IR: Aspirin Assay 2 Ways
2/19	Non-Aqueous Titrations
2/26	Midterm: Esterification Synthesis: Project I
3/05	Spring Break
3/12	Pesticide-Active Ingredient Isolation: Project II
3/19	Project II
3/26	Dye Prepaaration: Project III
4/02	Project III
4/09	Polymer-Preparation & Characterization: Project IV
4/16	Project IV
4/23	Research Tallk/Check Out
4/30	Final Exam

Requirements

Lab Questions/ 1st Half	150
Midterm	100
Homework/Technique	50
Final	100
Lab Notebook/2nd Half	150
Talks	50

Grading

>92%	A
90-92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
73-76	C
70-72	C-
<70	D
low attendance	F

Important **NOTE**: Eight (8) hours per week in the laboratory is MANDATORY to pass this class. Those averaging less than that by **March 27, 2007** are ADVISED to ***DROP*** rather than Fail.

Yearly Administrative Review
Industrial Chemistry Technology (ICT) AAS degree
Physical Sciences Department
Due: December 23. 2006

I. Summary of Modifications since last report:

Changes from last year's report may be found in the following sections:

II (d) and (e), in which we report on the assessment data that have been collected and how those data have been put to use (or how they may used to modify the program in the future).

The student/faculty achievement section has been updated. And while the program does not have a formal involvement in the American Democracy Project, there is a student organization that is closely related to the program (the student affiliate of the American Chemical Society, or SAACS), which has received national recognition from the parent organization. In addition, the program is engaging in an effort to reduce the credit hours required for graduation from 63 to 60 (and this effort is described in the body of the report).

II. Program Assessment/Assessment of Student Learning

a) What are the program's learning outcomes?

- Interpret and communicate basic chemical terminology.
- Perform calculations involving chemical reactions that require the application of the mole and related concepts.
- Relate material and energy balances of chemical equations.
- Predict the course of simple chemical reactions.
- Prepare mixtures of specified compositions when the components of the mixtures are expressed in different quantitative units.
- Follow directions in the preparation of materials.
- Use appropriate units with calculations.
- Keep a laboratory notebook according to proper specifications, including the notation of unexpected occurrences.
- Communicate chemical concepts and information clearly, both orally and in writing.
- Prepare compositions or compounds, given the directions. Identify references that might provide appropriate directions.
- Suggest the use of alternative materials in preparing compositions.
- Conduct chemical analysis under supervision.

- Use common scientific instruments (including, but not limited to, pH meter, IR and UV-vis spectrophotometers, liquid chromatography, gas chromatography) to analyze and characterize compounds.
- Conduct laboratory procedures in accordance with the basic rules of laboratory safety.
- Demonstrate competence in the use of computer software appropriate for the chemical industry, including word processing, spreadsheets and database management.

b) What assessment measures are used, both direct and indirect?
c) What is the assessment cycle for the program?

The assessment measures and assessment cycle are all detailed on the assessment plan submitted for this program with last year's YAR.

d) What assessment data were collected in the past year?
Data were collected in the following categories specified on the assessment plan:

1) **ACS Exam Data.** Standardized American Chemical Society (ACS) examinations have been administered to students in CHEM 121 and CHEM 122. Students in both of these classes tend to outperform the national median score.

2) **CHEM 322 laboratory performance.** Prelab and postlab tests have been administered in CHEM 332 (Organic Chemistry 2), in those sections where students are doing extended projects. These tests measure student abilities and attitudes towards laboratory work. In addition, students in CHEM 332 presented their long-term projects both in oral format to their peers in class and to a wider audience during an on-campus poster session at the end of the year.

3) **Performance in a manufacturing laboratory setting** The instructor of INCT 230 (Chemical Manufacturing and analysis) has evaluated the students' performance in this class.

4) **Laboratory notebooks.** Course instructors have evaluated notebooks of the students in lab-based chemical technology courses (most primarily in CHEM 317 and INCT 230). Students have used their notebooks as a demonstration of their laboratory performance when they apply for jobs in industry.

5) **Oral reports.** Students have been evaluated on the oral presentations they make during their final year in the program.

e) How have assessment data been used for programmatic or curricular change?

1) Over the next 18 months, we intend to break down the performance on ACS examinations by subcategories, in order to see where students are doing well and where they are doing not so well in the general chemistry sequence.

2) We have modified the projects portion of Organic Chemistry 2 to give students a more restricted set of projects, rather than an open wide choice. We will see in the future if this change results in better student performance.

3) The last learning outcome refers to students' ability to use word processing and spreadsheet software in a work place setting. Upon evaluation of students' performance in INCT 230 (referred to above) and upon consent by some members of the advisory board, the program coordinator will begin efforts to drop ISYS 105 from the curriculum. The evidence suggests that students satisfactorily learn the skills they need within the context of the program courses.

Course Outcomes Assessment

a) Do all multi-sectioned courses have common outcomes?

Among the four "core" program courses (CHEM 140, CHEM 145, CHEM 240, CHEM 245), only one has multiple sections (CHEM 245). However, the two laboratory sections associated with this course are taught by the same instructor, so they have the same learning outcomes.

b) If not, how to you plan to address discrepancies?

Not applicable

c) How do individual course outcomes meet programmatic goals?

Taken together as a group, the four core courses listed above address all of the learning outcomes shown in IA.

III. Program Features

1. Advisory Board

a) Does the program have a board/committee? When did it last meet? When were new members last appointed? What is the composition of the committee (how many alumni, workplace representatives, academic representatives, etc.)

Yes, we have an advisory board, but by a different name. By the recommendation of the American Chemical Society (ACS), we have scrapped the "advisory board" or "advisory committee" model and have moved towards an "industrial-educational alliance" model. This step, in fact, is necessary to maintain approval by the ACS. At this time, the membership on the board is roughly split equally among Ferris alumni,

other (non-Ferris) workplace representatives, and academic representatives. The last meeting of the board was two years ago

b) If no advisory board exists, please explain by what means faculty receive advice from employers and outside professionals to inform decisions within the program.

Not applicable.

c) Has feedback from the Advisory Board affected programmatic or curricular change?

Yes. For example, more opportunities for making oral presentations were incorporated into the program (and these presentations are being assessed). In addition, the program coordinator will begin an effort to drop ISYS 105 from the curriculum (for reasons outlined above). This will bring the total number of required credits to graduation for this two-year program to 60 credits, exactly half the number of FSU-mandated credits for most four-year programs (120 credits).

2. Internships/Cooperative or Experiential Learning

a) Is an internship required or recommended?

Internships are not a formal part of the program. Companies do offer summer internships for chemical technicians, and the program coordinator facilitates the interview process for those students who elect an internship.

b) If the internship is only recommended, what percentage of majors elect the internship option?

Depending on the year, up to three program students may opt for a summer internship.

c) What challenges does the program face in regard to internships? What is being done to address these concerns?

At this time, due to the poor economic circumstances of the large chemical companies in the state of Michigan, these companies are offering fewer internships than in years past. When these companies recover, more students should be placed as interns in the future.

Furthermore, the final course in the program (CHEM 245, Chemical Manufacturing and Analysis) provides students with a working environment similar to that expected on the job. This gives all of the program graduates an “internal internship” experience.

d) Do you seek feedback from internship supervisors? If so, does that feedback affect pedagogical or curricular change?

When students return from an internship, the program coordinator interviews both the student and his/her supervisor to examine the relationship between the education that has been provided and the student's readiness to participate as an intern.

3. On-line courses

a) Please list the web-based courses, both partial internet and fully online, offered last year.
b) What challenges and/or opportunities has web-based instruction created?
c) What faculty development opportunities have been encouraged/required in order to enhance web-based learning within the program?
d) How has student feedback been used to enhance course delivery?
e) Is there any plan to offer this program on-line? If yes, what rationale is there to offer this program online? (emerging market opportunity? Expand enrollment? Demand for niche program offering? etc.)

Due to the lab-based nature of this program, we have not offered courses on-line; nor do we expect to offer such courses on-line in the near future.

4. Accreditation

a) Is the program accredited?
b) By whom?
c) When is the next review?
d) When is the self-study due?
e) How has the most recent accreditation review affected the program?

"Combined" answer to the above questions: The program is not accredited, because there is no accrediting agency for two-year programs in chemistry. The program, however, is **approved** by the Chemical Technician Program Approval Service (CTPAS), an arm of the American Chemical Society. Accreditation in chemistry is done only at the bachelor's level and above. The entire list of approved programs (ten nationwide) is found at this website:
www.chemistry.org/portal/a/c/s/1/acsdisplay.html?DOC=education%5Cinstitutional%5Capproved_schools.html

5. Student/Faculty Recognition

a) Have students within the program received any special recognition or achievement?

Six Ferris students presented papers at the National American Chemical Society Conference in Atlanta GA in March 2006.

Chemistry major and former ICT student **Emmanuela Ohaeri** was featured in an article in Chemical and Engineering News, a weekly publication for chemists and chemical engineers. Her role as current president of an award-winning student affiliate chapter of the ACS was highlighted in this article.

b) Have faculty within the program received any special recognition or achievement?

Pasquale Di Raddo, as the faculty advisor of the ACS student affiliate (SAACS), won nationwide recognition from the American Chemical Society (ACS) for this student affiliate as one of the top chapters in the country. For the third year in a row, our local chapter was also recognized as a "green chapter" for its efforts in promoting green chemistry.

Pasquale Di Raddo continues to serve on the committee for chemical technicians, a national committee of the American Chemical Society (ACS).

Bill Killian (ICT program coordinator) **and David Frank** (Physical Sciences department head) served as part of an invited panel presentation on the direction and future of chemical technology programs at last summers Biennial Conference on Chemical Education (BCCE), held on the campus of Purdue University.

Pasquale Di Raddo was recognized as the FSU "Teacher of the Year" in April 2006.

6. Student Engagement

a) Is volunteerism and student engagement a structured part of the program?
No

b) Does the program utilize service learning in the curriculum?
Service learning/volunteerism/student engagement is not a structured part of the program itself. However, the Department of Physical Sciences (and, by extension, the Chemistry BA program) sponsors the SAACS (Student Affiliate – American Chemical Society). Not only does this organization take part in raising the awareness of students regarding the profession of chemistry, but it also provides several service opportunities for students. Among these are: sponsorship of a "chemical demonstration" speaker for local middle schools, tutoring of students, presentations to local K-12 classrooms, science fair judging, etc.

c) Does the program participate in the American Democracy Project?
Not as a program. However, see the paragraph above. This year the SAACS is averaging 70 students at each of its meetings. Not only are chemistry, biochemistry and chemical technology students active in the organization, but it is also attracting several students who have a strong interest in chemistry, including pre-optometry (last year's president is now attending optometry school) and pre-pharmacy students.

IV. Academic Program Review Recommendations:

Please indicate the recommendations (enhancements or changes) made by APRC in the most recent review of the program by the APRC council. What actions have been taken in response to these recommendations?

The program is currently engaging in the data-collection efforts for the APRC report that must be submitted by June 2007.

Areas of Strength:

1) It is one of a small number of two-year chemical technology programs (fewer than twenty nationwide) that has received national approval by CTPAS (Chemical Technology Program Approval Service), an arm of the ACS (American Chemical Society).

2) This is a fairly inexpensive laboratory-based program for the University, because it contains an extensive core of CHEM and PHYS classes taken by students in several other programs across campus.

3) Students receive intensive, hands-on experience in chemical or industrial labs in each semester of the program.

4) The program emphasizes work skills throughout, including safety training, notebook keeping and communication skills (both oral and written).

Areas of concern (and proposed actions to address them):

1) **Concern:** Continue to be a contributing member of training to the MI technical workforce, even as it shrinks.
   Proposed action: Work with a larger base of employers, including smaller companies within the state of Michigan and an expanding base of employers throughout the Midwest.

2) **Concern:** Work with the employers outside of the state.
   Proposed action: Solicit input from all of our employers (including out-of-state employers) to ensure that our graduates are properly trained for a variety of entry-level positions.

Future goals:

1) Work with graduates to complete their educational experience. Last summer we explored the possibility of setting up an off-campus chemistry BA completion program in Midland, due to the number of program graduates at Dow Chemical

and Dow Corning. This particular effort was not fully realized because the number of interested students did not reach a level of viability for offering such a program. In the future we will consider a more on-line oriented version of such a program, so that we can pool graduates from Midland, Kalamazoo and other locations around the Midwest where our graduates are employed.

2) Work with employers who have needs for in-house specialized training on a short-term basis for chemical technicians. In the past, we have provided such training to the (now-defunct) Pfizer plant in Holland MI and to Pharmacia (now Pfizer) in Kalamazoo MI.

Other Recommendations:

None

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William Killian

Education: North Park College, B.A. Biology, 1973 Magna Cum Laude Graduate

Ohio State University, M.S. Chemistry, 1976 Area of Research: Synthesis and Characterization of Substituted Dihydropyridines in Relation to NAD.NADH Models.

Recent Experience:

Summer 1996-2004: Coordinate and teach at Pfizer Pharmaceuticals in the Technician Certification Program.

Summer 1994: Visiting Scientist at Dow Chemical Company, surfactant research

Summer 1988-90: 1992-93: Research Associate at Argonne National Laboratory, FTIR, HPLC and Safety Studies

Summer 1991: Research Associate at The Upjohn Company, HPLC method development

1987-Present: Professor, Industrial Chemistry Technology Program Coordinator Ferris State University courses taught:

- General Chemistry
- Laboratory Safety
- Applied Analytical Chemistry
- Instrumental Analysis

1985-86: Instructor at George Williams College, full time position College closed in March 1986 due to financial exigency

1984-85: Instructor at Loop Junior College

1981-85: Chemist/Manager at Inland Steel
2 years as an EPA compliance water/waste water chemist
2 years as a quality control manager for chemical operations at a rolling mill

Reports, Publications, Presentations

"N-ACYL-1, 4-Dihydropyridines by Acid Catalyzed Condensations," Tetrahedron Letters, 16, 1407-1410, 1978.

"Development of a Process for Treating Red Water by Organic/Inorganic Separation and Biodegradation", 14th Annual Army Environmental R&D Symposium, Williamsburg, VA, November 14-16, 1989.

"Detection of Chemical Plumes Utilizing Passive-Remote Fourice Transform FTIR Spectroscopy", 44th Annual Pittsburgh Conference and Exposition on Analytical Chemistry, Atlanta, GA, March 8-12, 1993.

"The Role of an Industrial Advisory Board in a Chemical Technology Program", 15th Biennial Conference on Chemical Education, Waterloo, Ontario, August 1998.

"How to Obtain Accreditation for a Two-Year Industrial Technology Program", ACS Regional Meeting, Midland, Michigan, October 1997

"A Mechanic Representation for the Synthesis of Benzanthrone and Violanthrone", 17th International Symposium of Polycyclic Aromatic Compounds, Bordeaux, France, October 1999.

"A Mechanic Representation for the Synthesis of Benzanthrone and Violanthrone", Journal of Polycyclic Aromatic Compounds vol. 19, pp 179-187, 2000

"Chemistry 317 Laboratory Manual" Winter 2002

American Chemical Society/CTPAS Self Study Report Winter 2005

Roundable discussion of curricular and pedagogical issues in the design of chemical technology programs. Biennial Conference on Chemical Education (BCCE), West Lafayette, Indiana, 2006.