Assessment of Learning for Career and Technical Programs

Program Name: Computer Aided Drafting

Academic Years:
2007-08    2008-09    2009-10

Associate of Applied Science Degree:
Computer Aided Drafting

Certificate of Achievement:
Computer Aided Drafting
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College Mission Statement:
St. Charles Community College enriches our community by providing life-changing educational and cultural opportunities focused on personal growth and student success in a global society.

College Vision Statement:
We will be a community college recognized for leadership in academic excellence, student success, instructional and technological innovation, and community responsiveness.

Computer Aided Drafting Program Mission Statement:
Our program mission is to provide students with training and education leading to gainful employment as entry level CAD technicians, capability to transfer credits to appropriate four-year technical degree programs, or a skill set applicable to a technical occupation.
CAD Program Goals:

Computer Aided Drafting Certificate of Achievement: The primary goal is to prepare recipients for entry-level employment as a beginning drafter. Elective CAD courses have a wide scope to relate to a variety of employment situations. Courses are applicable for later pursuit of an A.A.S. degree, if desired. Students who desire formal CAD certification as an (optional) skill component in another technical profession (e.g. engineering, architecture) are also accommodated.

A.A.S. Degree Computer Aided Drafting: This degree is prepares students for employment with architectural firms or contractors, engineering or manufacturing firms (with product design emphasis), where more developed math, communication, and drafting skills are desired. Graduates may elect to transfer credits to an appropriate 4-year program to earn a B.S. in various appropriate Technology programs (or advance to become a certified technical instructor).

In addition, numerous employed personnel from the community (e.g. architects, designers, engineers, drafters, technicians) will pursue CAD coursework (non-degree track) to capture the latest software advances and methods. Some workplace personnel (managers, technicians, staff, company owners) may pursue introductory CAD classes for their workplace interaction and awareness when working with drafters and designers.

**Designated Full-Time Faculty Member:** David Niermann
Management Summary

The St. Charles Community College Computer Aided Drafting Program has made great progress in providing increased student learning opportunities, excellent student results, and competitive contributions in workplaces from SCC alumni. Management indicators have correlated well with these outcomes.

The CAD Program has a dedicated computer lab – workstation hardware has been upgraded to high memory, fast processing widescreen monitor units. Network printing/plotting capability has been recently upgraded (HP LaserJet 9040 printer and an industrial quality HP800 plotter). State-of-the-art software is involved, including the entire Autodesk education suite (2011 versions in general, architectural, electrical soon to be upgraded to 2012) which is available in two campus labs, and is also available for free student downloads per an arrangement with the Autodesk Educational Community¹. Solidworks software (2010-12 revs) is utilized for advanced 3D product applications. A SMARTBoard system has been implemented in the CAD lab.

Program and course design evolution has emphasized 3-dimensional design in numerous aspects. Introductory and intermediate Revit (3D architectural design) has been added. Civil drafting utilizes Civil 3D Map software. Solidworks (3D product design) is mandatory for Certificate and Degree requirements. A MakerBot² unit has been recently added for 3D build using student CAD designs. Google SketchUp 3D Animation has been a recent course addition.

Current instructors are highly rated and include the fulltime program coordinator and additional adjunct staff. Collective staff background includes field expertise (electronics, architecture, engineering, civil, construction), academic responsibility (coordinators for a private tech school and high school district), and management (technical hiring in industry).

Student assessment outcomes exceeded targets in every category. Measures include general assessments (math), and specific CAD criteria. A Certified SolidWorks Associate Examination³ has been an added measure with a positive trend. Students have also accumulated multiple awards⁴,⁵,⁶ and recognitions.

Graduate outcomes include 100% employment or continuing education for A.A.S. degree recipients (with positive employer feedback). The most recently assessed average wage was $16.35/hour. Student externships produce exciting opportunities every semester ranging from forensic laboratory layouts to wind turbine designs⁷.

All of the above were achieved while enrollments tripled (since 2003) and costs lowered >$50 per credit hour, enabling continued efficient student learning prospects.
I. Introduction and background

Analysis and measures for the program continue to include lead and lag indicators related to learning opportunities and results. Program process mapping exercises are inclusive of a broader learning structure from high school relationships through post-graduate employment and transfer to 4-year schools. Metrics have been established and are reviewed along with a Program Summary Report with the CAD Advisory Committee. Advisory Committee membership during this reporting period includes representatives from the City of Chesterfield (Missouri), Whittaker Homes, Fru-Con Inc., HBE Corp., Ozark Metallic Design, St. Louis Avionics, Tridaq Inc., Planet Tool Inc., Southeast Missouri State University, Fort Zumwalt School District, Missouri Department of Transportation, Health, Education, and Research Associates (HERA) Inc., Crime Lab Design, Inc., and ACTEMMx Inc.

Specific lead indicators relevant to student learning and program planning actions include:
- Software capabilities
- Community interaction opportunities
- High school articulation
- Student exhibit opportunities
- Recruiting and enrollments
- Cost stewardship

Relevant lag indicators are:
- WorkKeys test results
- Missouri Drafting Competency (self assessments)
- National CAD Skill Standards (self assessments)
- Capstone portfolio quality
- Annual Exhibit judging results
- Employment Placement Rate
- Employment Wages
- Feedback from employers
- 4-year university feedback about transfer students
- Awards or special recognition
- Cost management/budget results
WorkKeys testing involves Applied Math and Applied Technology computerized testing. The CAD Capstone course, CDM-298, is taken by students who have applied for graduation. Portfolio requirements for CDM-298 are:

- A selection of CAD drawings
- A resume
- Letters of recommendation
- Employment references
- An appointment with SCC’s Career Services Department – with follow up assistance with resumes, job seeking, mock interviews, etc. as desired

It is notable that a significant number of students will obtain employment or transfer opportunities without completing the full Certificate or A.A.S. program. These cases are not captured in this report analysis.
II. Data and results

IIa. WorkKeys Assessments

WorkKeys assessment results are as shown below:

<table>
<thead>
<tr>
<th>Degree/Certificate</th>
<th>WorkKeys Applied Math</th>
<th>WorkKeys Applied Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>NA**</td>
<td>NA**</td>
</tr>
<tr>
<td>A.A.S. – Industrial Technology*</td>
<td>NA**</td>
<td>5</td>
</tr>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>NA**</td>
<td>NA**</td>
</tr>
<tr>
<td>A.A.S. – Industrial Technology*</td>
<td>NA**</td>
<td>NA**</td>
</tr>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

*The (CAD) A.A.S. Architectural Technology and (CAD) A.A.S. Industrial Technology Degrees options were changed to a single Computer Aided Drafting A.A.S. Degree in the Spring Semester 2008 (08 SP). Students initiating coursework prior to 2008 had the option of grandfathering the previous Degree choices, if desired. **Test administration was unavailable fall semester 2007 (one student subsequently made up)

The Applied Mathematics test is a WorkKeys assessment administered by ACT, Inc., an independent non-profit organization. Results range up to a level 7 maximum. This Applied Math assessment “measures the skill people use when they apply mathematical reasoning, critical thinking, and problem-solving techniques to work-related problems. The test questions require the examinee to set up and solve the types of problems and do the types of calculations that actually occur in the workplace.”

The Applied Technology WorkKeys test is also administered by ACT, Inc. Results range up to a level 6 maximum. It “measures the skill people use when they solve problems with machines and equipment found in the workplace.” This skill includes four areas of technology:
electricity, mechanics, fluid dynamics, and thermodynamics. Individuals need to know the basic principles of each area. This test focuses on reasoning, not math. Therefore, individuals do not need to make calculations or use formulas to solve problems. When individuals use the Applied Technology skills, they can:

- Analyze a problem by identifying the problem and its parts.
- Decide which parts of a problem are important.
- Decide on the order to follow when dealing with the parts of the problem.
- Apply existing tools, materials, or methods to new situations.

**Applied Math**

A summary chart is shown below with WorkKeys assessment level descriptions.
<table>
<thead>
<tr>
<th>Level</th>
<th>Characteristics of Items</th>
<th>Skills</th>
</tr>
</thead>
</table>
| 3     | • Translate easily from a word problem to a math equation  
       • All needed information is presented in logical order  
       • No extra information | • Solve problems that require a single type of mathematics operation (addition, subtraction, multiplication, and division) using whole numbers  
       • Add or subtract negative numbers  
       • Change numbers from one form to another using whole numbers, fractions, decimals, or percentages  
       • Convert simple money and time units (e.g., hours to minutes) |
| 4     | • Information may be presented out of order  
       • May include extra, unnecessary information  
       • May include a simple chart, diagram, or graph | • Solve problems that require one or two operations  
       • Multiply negative numbers  
       • Calculate averages, simple ratios, simple proportions, or rates using whole numbers and decimals  
       • Add commonly known fractions, decimals, or percentages (e.g., 1/2, .75, 25%)  
       • Add up to three fractions that share a common denominator  
       • Multiply a mixed number by a whole number or decimal  
       • Put the information in the right order before performing calculations |
| 5     | • Problems require several steps of logic and calculation (e.g., problem may involve completing an order form by totaling the order and then computing tax) | • Decide what information, calculations, or unit conversions to use to solve the problem  
       • Look up a formula and perform single-step conversions within or between systems of measurement  
       • Calculate using mixed units (e.g., 3.5 hours and 4 hours 30 minutes)  
       • Divide negative numbers  
       • Find the best deal using one- and two-step calculations and then compare results  
       • Calculate perimeters and areas of basic shapes (rectangles and circles)  
       • Calculate percent discounts or markups |
Applied Math scores uniformly achieve a high level. Small sample sizes limit conclusive, thorough analysis and identification of causal relationships, nonetheless the evidence is that capability has been sustained with recent data/graduates.

<table>
<thead>
<tr>
<th>Level</th>
<th>Characteristics of Items</th>
<th>Skills</th>
</tr>
</thead>
</table>
| 6     | - May require considerable translation from verbal form to mathematical expression  
        - Generally require considerable setup and involve multiple-step calculations | - Use fractions, negative numbers, ratios, percentages, or mixed numbers  
        - Rearrange a formula before solving a problem  
        - Use two formulas to change from one unit to another within the same system of measurement  
        - Use two formulas to change from one unit in one system of measurement to a unit in another system of measurement  
        - Find mistakes in questions that belong at Levels 3, 4, and 5  
        - Find the best deal and use the result for another calculation  
        - Find areas of basic shapes when it may be necessary to rearrange the formula, convert units of measurement in the calculations, or use the result for further calculations  
        - Find the volume of rectangular solids  
        - Calculate multiple rates |
| 7     | - Content or format may be unusual  
        - Information may be incomplete or implicit  
        - Problems often involve multiple steps of logic and calculation | - Solve problems that include nonlinear functions and/or that involve more than one unknown  
        - Find mistakes in Level 6 questions  
        - Convert between systems of measurement that involve fractions, mixed numbers, decimals, and/or percentages  
        - Calculate multiple areas and volumes of spheres, cylinders, or cones  
        - Set up and manipulate complex ratios or proportions  
        - Find the best deal when there are several choices  
        - Apply basic statistical concepts |
Applied Technology
A summary chart is shown below with WorkKeys assessment level descriptions.¹⁰
<table>
<thead>
<tr>
<th>Level</th>
<th>Characteristics of Items</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>- Straightforward</td>
<td>- Identify how basic tools work</td>
</tr>
<tr>
<td></td>
<td>- One simple system that generally has two to five components</td>
<td>- Identify how simple machine parts work</td>
</tr>
<tr>
<td></td>
<td>- Situation exhibits clear physical symptoms</td>
<td>- Apply basic principles to solve problems involving a simple system</td>
</tr>
<tr>
<td></td>
<td>- Situation usually has only one variable</td>
<td>- Solve basic problems</td>
</tr>
<tr>
<td></td>
<td>- All needed information is present</td>
<td>- Identify the clear physical symptom that points to the potential source of a problem</td>
</tr>
<tr>
<td></td>
<td>- Only elementary technical terms are used</td>
<td>- Identify the best solution after eliminating clearly unsuitable possibilities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Characteristics of Items</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>- Moderately complex because they can involve two or more simple systems that work together or one moderately complex system</td>
<td>- Understand the operation of moderately complex tools and diagnostic equipment</td>
</tr>
<tr>
<td></td>
<td>- Systems may have up to ten components</td>
<td>- Understand the operation of moderately complex machines and systems</td>
</tr>
<tr>
<td></td>
<td>- Situation can have one or two variables</td>
<td>- Apply less obvious basic principles to solve problems within physical systems</td>
</tr>
<tr>
<td></td>
<td>- All needed information is present</td>
<td>- Solve moderate problems</td>
</tr>
<tr>
<td></td>
<td>- ExTRANeous information may be included</td>
<td>- Eliminate physical symptoms that do not point to the source of a problem, disregarding extraneous information</td>
</tr>
<tr>
<td></td>
<td>- Less common technical terms are defined</td>
<td>- Identify the best solution after eliminating other unsuitable possibilities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Characteristics of Items</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>- Moderately complex or advanced, involving two or more simple tools or systems that affect each other or a complex system that includes several components</td>
<td>- Understand the operation of moderately complex tools and diagnostic equipment, choosing the best tool for the task</td>
</tr>
<tr>
<td></td>
<td>- Systems perform somewhat complex operations and generally have more than ten components</td>
<td>- Understand the operation of complex machines and systems</td>
</tr>
<tr>
<td></td>
<td>- May involve two or three variables and may require use of technical knowledge</td>
<td>- Apply two or more principles of technology as they interact in moderately complex systems</td>
</tr>
<tr>
<td></td>
<td>- Extraneous information is often included</td>
<td>- Solve moderate and advanced problems</td>
</tr>
<tr>
<td></td>
<td>- Technical terms may be explicitly defined or their meaning can be implicit in context and illustrations</td>
<td>- Eliminate physical symptoms that do not lead to the source of a problem by disregarding extraneous information; use clues to find the source of a problem</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Identify the best solution after eliminating other unsuitable possibilities</td>
</tr>
</tbody>
</table>
Collectively, satisfactory results were achieved vs. the baseline target. It is not surprising that scores are somewhat lower in Applied Technology compared to Applied Math as specific items are involved (e.g. electronics, thermal behavior) that do not have frequent overlap in the CAD curriculum.

Overall, the result levels and distributions suggest capable foundational abilities. These results also correlate with student cases of successful advancement of their education to other majors (e.g. engineering).
## IIb. Drafting Standards Assessments

National CAD Skill Standards self assessments are summarized in the table below. “Drafting Skills” include basic drafting, orthographic projection, pictorial drawings, and dimensioning components. “Computer Skills” encompass hardware, physical needs, and operating systems. “Basic CAD” lists creation, editing, manipulation, analysis, and dimensioning items. “Advanced CAD” includes items in creation, editing, manipulation, analysis, and productivity categories.

<table>
<thead>
<tr>
<th>Degree/Certificate</th>
<th>Drafting Skills</th>
<th>Computer Skills</th>
<th>Basic CAD</th>
<th>Advanced CAD</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>92%</td>
<td>82%</td>
<td>83%</td>
<td>52%</td>
<td>76%</td>
</tr>
<tr>
<td>A.A.S. – Industrial Technology*</td>
<td>76%</td>
<td>59%</td>
<td>75%</td>
<td>41%</td>
<td>62%</td>
</tr>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>56%</td>
<td>94%</td>
<td>67%</td>
<td>21%</td>
<td>55%</td>
</tr>
<tr>
<td>A.A.S. – Industrial Technology*</td>
<td>80%</td>
<td>100%</td>
<td>100%</td>
<td>76%</td>
<td>87%</td>
</tr>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>60%</td>
<td>88%</td>
<td>54%</td>
<td>41%</td>
<td>58%</td>
</tr>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>72%</td>
<td>88%</td>
<td>75%</td>
<td>41%</td>
<td>66%</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>70%</td>
<td>76%</td>
<td>96%</td>
<td>66%</td>
<td>65%</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>84%</td>
<td>100%</td>
<td>75%</td>
<td>55%</td>
<td>76%</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>88%</td>
<td>94%</td>
<td>83%</td>
<td>62%</td>
<td>80%</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>56%</td>
<td>59%</td>
<td>54%</td>
<td>41%</td>
<td>55%</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>56%</td>
<td>94%</td>
<td>79%</td>
<td>24%</td>
<td>59%</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>96%</td>
<td>100%</td>
<td>88%</td>
<td>76%</td>
<td>88%</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>70%</td>
<td>76%</td>
<td>96%</td>
<td>66%</td>
<td>65%</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>96%</td>
<td>94%</td>
<td>96%</td>
<td>76%</td>
<td>89%</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>88%</td>
<td>100%</td>
<td>96%</td>
<td>83%</td>
<td>91%</td>
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</tbody>
</table>
*The (CAD) A.A.S. Architectural Technology and (CAD) A.A.S. Industrial Technology Degrees options were changed to a single Computer Aided Drafting A.A.S. Degree in the Spring Semester 2008 (08 SP). Students initiating coursework prior to 2008 had the option of grandfathering the previous Degree choices, if desired.

Missouri Drafting Competency self-assessment results are shown below. “Basic skills” encompass 65 items (drafting room procedures, tools & equipment, basic drawing, orthographic projection, auxiliary views, descriptive geometry, sectional views, pictorial drawings, dimensioning, tolerancing, applied math, and basic CAD skills). “Specialized or Advanced Skills” list 62 items (advanced CAD skills, architectural drawings, electrical drawings, pipe drawings, structural steel drawings, manufacturing drawings, civil/GIS drawings, and HVAC drawings). Reported results are the percentages of indicated adequate knowledge in a self-survey of items.

<table>
<thead>
<tr>
<th>Degree/Certificate</th>
<th>Basic Skills</th>
<th>Specialized or Advanced Skills</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>75%</td>
<td>60%</td>
<td>68%</td>
</tr>
<tr>
<td>A.A.S. – Industrial Technology*</td>
<td>78%</td>
<td>60%</td>
<td>69%</td>
</tr>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>78%</td>
<td>50%</td>
<td>65%</td>
</tr>
<tr>
<td>A.A.S. – Industrial Technology*</td>
<td>88%</td>
<td>44%</td>
<td>66%</td>
</tr>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>69%</td>
<td>35%</td>
<td>53%</td>
</tr>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>62%</td>
<td>47%</td>
<td>54%</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>86%</td>
<td>37%</td>
<td>62%</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>94%</td>
<td>45%</td>
<td>70%</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>98%</td>
<td>58%</td>
<td>79%</td>
</tr>
<tr>
<td>CAD Certificate</td>
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<td>42%</td>
<td>54%</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>62%</td>
<td>18%</td>
<td>40%</td>
</tr>
<tr>
<td>CAD Certificate</td>
<td>94%</td>
<td>42%</td>
<td>69%</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
<td>100%</td>
<td>100%</td>
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<td>56%</td>
<td>74%</td>
</tr>
</tbody>
</table>
*The (CAD) A.A.S. Architectural Technology and (CAD) A.A.S. Industrial Technology Degrees options were changed to a single Computer Aided Drafting A.A.S. Degree in the Spring Semester 2008 (08 SP). Students initiating coursework prior to 2008 had the option of grandfathering the previous Degree choices, if desired.

No specific targets exist for these assessments, in large part because they are a self-assessment exercise. There is no expectation for routine coverage of all drafting categories (i.e. untaken CAD elective courses and topics exist for all graduates). A scatter plot of results for the National and Missouri assessments is provided below:

Notable indications include
- Generally good coverage of drafting components
- A high correlation between National and Missouri results
- Higher results on National standards were typical, and analyzed further as shown in this t-test statistical table:
Cursory examination of these results suggests a higher proportion of specialized criteria exist with the Missouri standards, and thus less coverage with general program requirements. In fact, only four students scored higher on Missouri criteria vs. National were all A.A.S. graduates (more specific CAD course completions). This indication arises again with a t-test comparison of A.A.S. vs. Certificate graduate results showing more distinction for Missouri criteria (see tables below).

Overall, again sample sizes are small and confounding factors exist (e.g. Certificate students who have other majors such as Engineering, students with incoming skills or experience).
### IIc. Portfolio Assessments

Portfolio drawing examination results are shown below. Assessments are done by the Capstone instructor, with ratings of “commendable”, “satisfactory”, or “unsatisfactory”.¹¹

<table>
<thead>
<tr>
<th>Degree/Certificate</th>
<th>Portfolio Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>commendable</td>
</tr>
<tr>
<td>A.A.S. – Industrial Technology*</td>
<td>commendable</td>
</tr>
<tr>
<td>A.A.S. – Industrial Technology*</td>
<td>commendable</td>
</tr>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>commendable</td>
</tr>
<tr>
<td>A.A.S. – Architectural Technology*</td>
<td>commendable</td>
</tr>
<tr>
<td>A.A.S. – Computer Aided Drafting</td>
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<td>CAD Certificate</td>
<td>commendable</td>
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</table>

*The (CAD) A.A.S. Architectural Technology and (CAD) A.A.S. Industrial Technology Degrees options were changed to a single Computer Aided Drafting A.A.S. Degree in the Spring Semester 2008 (08 SP). Students initiating coursework prior to 2008 had the option of grandfathering the previous Degree choices, if desired.

Students are encouraged to provide an assortment of drawings from coursework or independent projects. As many as 30 drawings per student portfolio exist. Students fold larger drawings to fit into a convenient folder that they can bring to job interviews.

One clear historical trend is the increasing inclusion of 3D drawings, consistent with the direction of the occupation and the program emphasis. Below is an example photo of a 3D Revit portfolio submittal (3D architectural design).
IIId. Solid Modeling Assessments

A trial of voluntary assessments for the Certified Solidworks Associate (CSWA) Exam has been underway over the last three school years. This is an independent, 3 hour online examination administered by DS Solidworks, Inc. Solid modeling incorporating 3 dimensional design is an evolving component of CAD. Currently, two courses are offered in solid modeling in this curriculum. Students who completed these (only these) two courses were offered the optional opportunity to take the CSWA examination. A 70% achievement is required for passing and formal certification. Exam components are:

- Sketch entities - lines, rectangles, circles, arcs, ellipses, centerlines
- Sketch tools - offset, convert, trim
- Sketch relations
- Boss and cut features - extrudes, revolves, sweeps, lofts
- Fillets and chamfers
- Linear, circular and fill patterns
- Dimensions
- Feature conditions – start and end
- Mass properties
- Materials
- Inserting components
- Standard mates - coincident, parallel, perpendicular, tangent, concentric, distance, angle
- Reference geometry – planes, axis, mate references
- Drawing sheets and views
- Annotations

An increasing number of students have passed this examination, and is considered very satisfactory in light of only 2 solid modeling course offerings.
IIe. Program Fiscal Management

Program fiscal management is briefly included here because of its indirect relevance to student learning – more efficiency and cost effectiveness should result in better or additional offerings and learning opportunities.

Per planning, including job market evaluation and CAD Advisory Committee inputs, Computer Aided Manufacturing (CAM) was eliminated. Historically, SCC only offered one CAM course but maintained software licenses and equipment. Enrollment (maximum of 3 students per course) and job opportunities (zero in assessment period) have been extremely low. A number of other cost reductions were realized in software, but with a net gain in CAD lab capabilities.

![CAD Software Costs Chart]

KEY DRIVERS:
- Eliminated CAM
- Eliminated Roxio
- Eliminated Photoshop standalone
- Eliminated Eagle Point Civil
- Restructured Autodesk
- Restructured Solidworks
- New Autodesk supplier

2004-05 2009-10 2010-11 (projected)
Textbook scoping efforts were broadened to identify higher value texts, especially of interest with the financial situations of some students. A number of improvements were identified, resulting in higher quality and lower cost (see graph below):
Other improvements over time has resulted in the overall trend graphed below, with the most suitable reference by “the Kansas Study”\footnote{12}
### IIf. Employment Data

SCC Career Services Department survey data\(^{13}\) suggests a general increase in wages over time.

#### Average Hourly Wage of SCC Graduates With AAS & AS Degrees

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<thead>
<tr>
<th></th>
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<tr>
<td>CAD</td>
<td>$16.35</td>
<td>$16.21</td>
<td>NA</td>
<td>$15.02</td>
<td>NA</td>
<td>$14.41</td>
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</tbody>
</table>

Due to recent difficult job placement conditions, especially in the entry level market, a more detailed case-by-case analysis of 2010 graduates, May 2011 graduates, and pending December 2011 graduates was performed. Summary results are below:

<table>
<thead>
<tr>
<th>Current/past graduates through May 2010 through May 2011*</th>
<th>Employed** or Continuing Education</th>
<th>Excluded due to military assignment, personal, or medical reasons</th>
<th>Not employed and not seeking additional education</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A.S.</td>
<td>8</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Certificate</td>
<td>4</td>
<td>0</td>
<td>1</td>
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</table>

<table>
<thead>
<tr>
<th>Future graduates December 2011</th>
<th>Employed** or Continuing Education</th>
<th>Excluded due to military assignment, personal, or medical reasons</th>
<th>Seeking employment, not seeking additional education</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A.S.</td>
<td>3</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Certificate</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

*excludes students with significant transfer hours from other institutions  
**includes part-time and temporary employment

Historically, approximately 40% of SCC CAD job postings specify an Associates Degree.\(^8\) In the current job market, indications are a potential threshold exists for Certificate graduates.

Although unquantified, the number of job offers per student has been observed as declining with economic conditions over the last few years.

Cases are known, but not quantified, of students obtaining employment (and withdrawing from college) before completing degree or certificate requirements.
III. **Discussion of data with Program Faculty and Advisory Committee**

Annual reviews of assessment results \(^{14}\) are held with the CAD Advisory Committee and Program Faculty (see Attachments Section for meeting minutes). A number of curriculum changes were successfully implemented – many reinforce their direction for three-dimensional design incorporation. Current program/curriculum guides are provided in the Attachments.

The Advisory Committee has given strong direction for hardware accessories to 3D design, specifically a rapid prototype machine or 3D printer. Budget limitations have been prohibitive to date for conventional units costing $25K-50K. However, a “MakerBot” unit was proposed and funded through the SCC Foundation mini-grant (less than $1K) – see proposal in Attachments. The SCC Student Engineering Club (see below photo) built and tested the MakerBot kit. Current intentions are to incorporate with CAD students in the upcoming school year (see Action Steps).
An additional 3D related learning opportunity has been the support and development of Revit coursework. Revit is a three-dimensional architectural program that also allows shared users (e.g. multiple contractors for commercial design) and emphasizes design knowledge. Introductory and intermediate Revit courses have been developed and implemented since the last reporting period.

Approval of an introductory Geographic Information Systems (GIS) course for elective CAD credit occurred. GIS has overlap with civil drafting (including assessment standards referenced earlier).

Per Advisory Committee recommendations, hardware has been upgraded (in addition to an existing HP800 plotter):
- New SMARTBoard system (compatible with AutoCAD layers)
- New computer workstations (Dell 22” flat panel G2210t monitor, 8.00GB RAM, Windows 7 64 bit Operating System, Intel Core Duo 3.00 GHz processor)
- Network HP LaserJet 9040 printer

The Advisory Committee has also supported to migration to the Autodesk Educational Suite, utilizing the newest revisions for general, architectural, and electrical programs. In addition, Solidworks software is being maintained with upgraded versions.

Discussion with Advisory Committee members has also reinforced the recognition of globalization in some design and drafting work. Some instruction components can be emphasized in light of long distance situations between co-workers or drafters/clients (see Action Steps).

Articulation agreements with regional high schools continue to be developed with Advisory Committee supervision. The Fort Zumwalt School District is notable for its planning of courses and software to match the SCC curriculum. A significant update was made to the Francis Howell School District agreement since the last reporting period (see attachment).

Analysis of 6 years’ worth of SCC CAD job postings was performed to identify requested software brand expertise in workplaces. For those postings that requested a specific software, the results reinforce the emphasis on AutoCAD and Solidworks in this program. All Revit requests are recent and it is likely to gain proportion in the future.
The Advisory Committee has supported opportunities for student downloads of course software to enable learning and work off-campus. The number of Autodesk product student educational downloads is shown below:

NOTE: Summation >100% as some employers request more than one software brand
Additional support (WebCT, Moodle platforms) enabling more resources outside of class has been provided for 100-level courses.

A “2+2” transfer program has been completed with Southeast Missouri State University. An Associates Degree in Computer Aided Drafting from SCC will apply toward two years of credit in 4-year technical programs such as Industrial Technology, Construction Management, and Sustainable Technology. Formalization of other university transfer programs is an additional future educational opportunity.

Backing of online learning opportunities has been given by the Advisory Committee. An offering of online civil drafting was developed, approved, and piloted. An additional online course in Google SketchUp was approved.

The Advisory Committee has also advocated marketing, scholarship, and award activities as a means for broadening a community network enhancing student learning opportunities. Establishment of the Dennis Hollrah – Architect, Annual CAD Scholarship was started in 2009.

Marketing activities have included web site, print media, radio, and television (see screen shot below of Barbara Berndt – 2010 SCC CAD Student of the Year who achieved her goal of part-time employment while raising 3 children).
The SCC CAD Program has had a statewide winner (state winner, regional winner, or honorable mention) for six consecutive years in the Missouri Breaking Traditions Award (photo below is of Mary Rosner – 2011 Regional winner who was an incoming certified electrician who was successful in broadening her education and acquired employment in architectural/electrical design).
A Twitter account was started to communicate to students, the College, and the community.

SCC CAD Program
@SCC_CAD  Cottleville, MO
Computer Aided Drafting (CAD) Program at St. Charles Community College.
http://www.stchas.edu

SCC Cad Program
Congratulations to Mr. Davenport's CDM-222 class - 10 students passed the Certified Solidworks Associate Exam!
solidworks.com/sw/support/796...
27 Jul

SCC Cad Program
Associates Degree Guide... courses do not necessarily need to be taken in this order.... see Prof N. if questions.
http://twitpic.com/5t27nn
20 Jul

SCC Cad Program
20 Jul

SCC Cad Program
Pic from CDM-270 externship - Brandon Fix at Freiezo - wind energy design www.freiezo.com http://twitpic.com/5t1xb9
20 Jul

SCC Cad Program
List of fall semester CAD courses (including non-CDM courses approved as CAD electives).... http://twitpic.com/5t1w7h
20 Jul
Recognition of student successes takes place at Advisory Committee meetings, as well. First hand involvement with these students has been very rewarding. Just as important, they have been very informative learning case studies. One meeting example featured three students (photo below) who won the “CAD Student of the Year” award in 2007, 2008, and 2009 – all three had successes unique to a community college learning path).

On the left – Mike Kuhlmann (2009) – a high honors student who realized his educational path by attending night school while working fulltime. Mike provided key advice to the Program on Revit usage and value in the workplace. Mike provided a demonstration of Revit and the interaction of multiple contractors in a shared design (Mike works at a St. Louis equipment/facilities design firm).

In the middle – Marilynn Gwin (2007) – a student who had a dream of architectural design in high school, but was discouraged to pursue a technical career because of her gender. Instead, Marilynn became a nurse but still kept manual drafting tools in her basement. Decades later, she took a beginner CAD class at SCC and advanced to graduate with numerous student achievements and job offers, and a current position as a high-level drafter in a St. Louis architectural firm.

On the right – Kevin Muich (2008) – a student who completed a military assignment before coming to SCC. Kevin began in drafting and took great interest in civil drafting and engineering (in part, by obtaining a CAD externship with a St. Louis civil engineering company). Kevin transferred to SCC’s Pre-Engineering Program after graduating in CAD, and subsequently transferred directly to Cornell University and is currently finishing his Bachelor’s Degree in Civil Engineering. Kevin intends to go to graduate school either to the University of California-Berkeley or Stanford University.
VI. **Action steps**

- Incorporate “globalization/long distance CAD communication” learning items into 100-level course design – include image attachment, external references, external datalinks, attributes, ribbon usage, icon usage, and hand sketching (useful for quick concept communication)

- Test MakerBot 3D use with upcoming CAD Capstone classes as a potential class project

- Investigate Moodle for 200-level course online support materials

- Investigate feasibility of a cost-effective AutoCAD certification examination

- Explore unpaid internship opportunities for students with our employer network

- Continue to pursue private (SCC Foundation) funding – consider prioritization of tutors for enhanced support outside of class for students

- Continue to identify and formalize transfer opportunities to universities for four year technical programs (e.g. automobile design technology, engineering technology, construction management)

- Assess online supplementary teaching aids for relevant coursework (e.g. Solid Professor)

- Continue incorporation of sustainable building items, green technology, and LEED standards into appropriate course designs

- Continue to identify high return-for-investment opportunities with the community, including updated (electronic) marketing materials, high school instructor workshops, and/or student competition hosting.

- Continue to identify suitable field trip opportunities for workplace visits by CAD classes
References

Attachments

CAD Advisory Committee Meeting Minutes (note absentees get offline materials and input opportunities)  p. 36

SCC CAD Program/Course Guides  p. 39

MakerBot Grant Proposal  p. 41

CAD Skill Standards (National and State of Missouri)  p. 46

Articulation Agreement with Francis Howell School District  p. 48
CAD Advisory Committee Meeting Minutes – November 18, 2009

Attendees: Tim Busse (Whittaker Homes), Steve Ecker (Tridaq Corp.), Chris Breitmeyer (SCC Dean – Math, Science, and Health Division), Kieran Vaughn (HBC, Inc.), Daniel Hull (Fru-Con Engineering), June Nunn (City of Chesterfield), Ken Schnurbusch (St. Louis Avionics), Brett Richardson (Southeast Missouri St. U.), David Brown (Fort Zumwalt School District), Dave Niermann (SCC CAD Program Coordinator)

1. The meeting was called to order at 6:35pm
2. Introductions were made, and the past 3 CAD Program “Students of the Year” were introduced for (well received) recognition
3. Agenda approved
4. Minutes from 11/11/08 meeting approved
5. No old business
6. New business
   Handout – CAD Program – Key Goals and Results Summary – Reported on numerous items within the college goals/planning structure. Highlights included:
   - >100 free AutoCAD home downloads for students
   - 100% placement for December, 2009 graduates
   - Certified Solidworks Associate exam establishment for Solid Modeling II class
   - Revit Architecture software and class implemented ahead of schedule
   - Graduates doing very well (e.g. Capstone requirements, informal employer feedback)
   - Marketing activities ongoing (e.g. recent college Majors Fair staffed with 3 CAD employers, Spring 2010 schedule with a CAD student on the cover)
   - Enrollments are trending high (e.g. >200% higher vs. 4 years ago)
   - 22 entries in latest annual CAD Student Exhibit & Competition
   - Potential future opportunities for CAD student involvement with college include tutoring positions and design of an outdoor classroom at Rabbit Run Park
   - Capital priorities were reviewed
   - Financial stewardship was demonstrated (e.g. below budget on discretionary spending, software costs greatly lowered, student book costs lowered 2X in last 5 years)
   - 16 action items from this committee completed over the past 2 years
7. Action items (for SCC CAD Department unless otherwise noted)
   - Arrange WebCT (online course management system) training as needed for all faculty – expectation is for all classes to have their syllabus posted for the next school year
   - Incorporate CAD into an upcoming potential STEM (Science, Technology, Engineering, and Math) scholarship plan
   - Communicate Revit opportunity to SCC Theater Dept.
   - Investigate student AutoCAD certification opportunities – consider incorporation into the Capstone course, if appropriate
   - Prioritize an existing inventory item of hosting special events for regional high school faculty and/or students. Examples are a summer session for high school faculty to demonstrate CAD software/program capabilities and hosting a student competition event. It was noted that these items were not moving ahead due to resource limitations – several adjunct graciously volunteered to help with activities
8. The meeting was adjourned at 7:45pm
CAD Advisory Committee Minutes of November 11, 2008

Attendees: Tim Busse (Whittaker Homes), Steve Ecker (Tridaq Corp.), Chris Breitmeyer (SCC Dean – Math, Science, and Health Division), Phil Tiller (Lewis & Clark Career Center), Kieran Vaughn (HBC, Inc.), Daniel Hull (Fru-Con Engineering), June Nunn (City of Chesterfield), Dave Niermann (SCC CAD Program Coordinator)

1. The meeting was called to order at 6:40pm
2. Agenda approved
3. Minutes from 11/15/07 meeting approved
4. No old business
5. New business
   Handout – CAD Program Performance Summary – Reported on several completed committee action items, including:
   SMARTBoard installation in TECH204
   Reorganization of TECH204 to accommodate a 3D printer
   Approval of Introductory GIS as CAD elective credit
   Handout – Powerpoint recruiting file
   Increased marketing activity correlated well with higher enrollments
   Handout – Biennial Assessment of Learning for CAD Program
   Graduate measures have been positive and correlate well with reported workplace performance
   Overall, very positive comments were made about the CAD program management and performance
   Scholarship Opportunity
   Reported on the development of the first program specific scholarship – the Dennis Hollrah, Architect – Computer Aided Drafting Annual Scholarship
   Revit Software
   Significant inputs were received on the increasing interest and value of Autodesk Revit (a Building Information Modeling package that can be shared among multiple users). Suggestions were made to assess incorporation into the CAD program.
   Sustainability/Green Building
   Considerable discussion occurred on the importance of sustainable/green building practices and design, especially with college and program activities relative to community leadership.
   Board Drafting/Hand Sketching
   It was noted that board drafting incorporation was still under consideration, but not prioritized due to the high amount of students taking 1-2 CAD courses only for workplace computer knowledge. Hand sketching modules continue to be used in several courses.
6. Action items (for SCC CAD Department unless otherwise noted)
   Assess options and feasibility of Revit software purchase and curriculum incorporation – include expert inputs from committee members offline as appropriate (Program Coordinator note: after the meeting, it was requested to include ArchiCAD in the overall assessment)
   Assess and implement appropriate items related to sustainable building in architectural drafting/design, course offerings and activities.
7. The meeting was adjourned at 7:50pm
CAD/CAM Advisory Committee Meeting - Minutes of November 15, 2007

Attendees: David Brown (Fort Zumwalt School District), Tim Busse (Whittaker Homes), Steve Ecker (Tridaq Corp.), Pat Porterfield (SCC Dean – Math, Science, and Health Division), Ken Schnurbusch (St. Louis Avionics), Kieran Vaughn (HBC, Inc.), Carl Von Bastian (Ozark Metallic Design), Dave Niermann (SCC CAD Program Coordinator)

1. The meeting was called to order at 6:40pm  
2. Agenda approved  
3. Minutes from 10/19/06 meeting approved  
4. No old business  
5. New business

Handout – Program Results Update  
It was noted that the results of the annual student exhibit showed improved capabilities vs. previous years. 
Most of the students in St. Charles County have manual drafting experience in high school (NOTE: this was validated post-meeting with class inquiries). 
Cases of student placement before graduation exist, but are not analyzed.

Handout – Z-Corporation 3D Printer Powerpoint slides  
Several rapid prototyping methods/products were analyzed, and a 3D printer capability was recommended for further assessment due to cleanliness, safety, compatibility with a computer lab environment, speed, and low maintenance 
Very positive inputs were received about the value of 3D printing capability for all drafting categories, including architectural drafting 
Example products were examined 
Received very strong recommendations to replace the unused shop equipment in TECH204 with a suitable 3D printer.

Handouts – Survey of CAD Student Interests, Course Requirements, Job Posting Information  
It was reported that architecture was the most frequent student interest category 
Most industrial interests were for 1-2 classes only 
CAM software courses have had very low enrollment historically 
Most of the job postings were for architectural drafting 
AutoCAD and Solidworks were the 2 most frequent software packages specified in job postings 
Industrial and architectural course requirements have been made more uniform already in recent years

Handout – FZ Industrial Technology Problem Set (courtesy, David Brown)  
Coordination of sketching, classic CAD, and modeling was noted 
The value of hand/board drawing fundamentals was regarded to be high

6. Action items (for SCC CAD Department unless otherwise noted)  
Prepare a proposal for a 3D printer purchase  
Surplus existing shop equipment in TECH204  
Propose dropping CAM and concentrate on having a focused CAD program only  
Discontinue MasterCAM license ($9K/year savings)  
Evaluate a merged, robust A.A.S. CAD Degree, vs. existing Architectural & Industrial A.A.S. degrees (students can still concentrate optional course selections in architectural, industrial, civil, or other interests)  
Survey recent high school graduates on board drawing value with CAD perspectives  
Assess possibilities of a prototype board drawing station(s) in TECH204

7. The meeting was adjourned at 8:45pm
Effective March 2008, the Architectural/Industrial CAD degrees have been changed to Computer Aided Drafting. Students starting Summer 2008 or after will earn the new degree in Computer Aided Drafting.

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Second Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDM 103 Intro to CAD System</td>
<td>2 ART 110 Drawing I</td>
</tr>
<tr>
<td>CDM 104 CAD Systems II</td>
<td>3 CDM Electives</td>
</tr>
<tr>
<td>ENG 101 English Comp I *</td>
<td>3 ENG 115 Technical Writing</td>
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<tr>
<td>CPT/BAS 103 Micro Appl. Using MS Office</td>
<td>3 PHY150/153 General Physics I</td>
</tr>
<tr>
<td>MAT 171 Pre-Calculus or both * MAT 150 &amp; MAT 160</td>
<td>6or7 17or18</td>
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</tbody>
</table>

**Summer Semester**

| General Elective *** | 3 |

<table>
<thead>
<tr>
<th>Third Semester</th>
<th>Fourth Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDM 205 Architectural Drafting I</td>
<td>3 HIS/POL History or Political Science **</td>
</tr>
<tr>
<td>General Elective ***</td>
<td>3 SPE 101 Oral Communications</td>
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<tr>
<td>CDM Elective ∨</td>
<td>6 CDM Electives ∨</td>
</tr>
<tr>
<td>CDM 221 Solid Modeling I</td>
<td>3 CDM 298 CAD/CAM Capstone</td>
</tr>
<tr>
<td>**</td>
<td>16</td>
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**TOTAL HOURS REQUIRED – 66-68**

*Choose 20-21 hours from the following CDM electives:

<table>
<thead>
<tr>
<th>CDM 120 Descriptive Geometry</th>
<th>2 CDM 222 Solid Modeling II</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDM 206 Architectural Drafting II</td>
<td>3 CDM 223 Geometric Dimensioning/Tolerance</td>
</tr>
<tr>
<td>CDM 207 Revit Architecture I</td>
<td>3 CDM 235 Manufacturing Processes</td>
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<tr>
<td>CDM 208 Revit Architecture II</td>
<td>3 CDM 251 Introduction to Piping Drafting</td>
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<tr>
<td>CDM 209 Construction Materials</td>
<td>3 CDM 255 Civil Drafting</td>
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<tr>
<td>CDM 210 HVAC Drafting</td>
<td>3 CDM 270 Externship</td>
</tr>
<tr>
<td>CDM 211 Structural Drafting</td>
<td>3 CPM 220 3D Animation</td>
</tr>
<tr>
<td>CDM 212 Electrical/Electronic Drafting</td>
<td>3 GEO 120 Introduction to GIS</td>
</tr>
</tbody>
</table>

*The Academic Skills Assessment is required before enrolling in math or English courses. If a student places into lower level courses than are required for his/her degree, then the student needs to first enroll in lower level courses before enrolling in the courses needed for graduation.

**Choose from one History or Political Science course HIS 101, 102, 115, or 270; POL 101 or 102.

*** General Elective: Choose any course 100 level or higher.

The student earning an Associate of Applied Science Degree needs to be aware that the courses taken for the degree are specifically designed to help in obtaining employment after earning the degree and are not designed for transfer to a four-year institution. If the student wants to transfer courses, then the Associate of Arts Degree should be pursued.

For further details about this program, please contact department chairman David Niermann at 922-8561 or dniermann@stchas.edu.
## ST. CHARLES COMMUNITY COLLEGE
### CERTIFICATE OF ACHIEVEMENT
#### COMPUTER AIDED DRAFTING

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Second Semester</th>
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<tr>
<td>CDM 103 Intro to CAD Systems</td>
<td>CDM 221 Solid Modeling I</td>
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<tr>
<td>CDM 104 CAD Systems II</td>
<td>CDM Electives *</td>
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<td>HIS/POL History or Pol. Science **</td>
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<tr>
<td>CPT/BAS 103 Micro Appl. Using MS Office</td>
<td>CDM 298 CAD Capstone</td>
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<tr>
<td>MAT 098 Beginning Algebra or higher***</td>
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*CDM Electives: (choose four)*

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<th>CDM 222 Solid Modeling II</th>
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<tbody>
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<td>CDM 205 Architectural Drafting I</td>
<td>CDM 223 Geometric Dimensioning/Tolerance</td>
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<td>CDM 206 Architectural Drafting II</td>
<td>CDM 231 Tool Path Generation</td>
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<td>CDM 207 Revit Architecture I</td>
<td>CDM 235 Manufacturing Processes</td>
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<td>CDM 208 Revit Architecture II</td>
<td>CDM 251 Introduction to Piping Drafting</td>
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<td>CDM 209 Construction Materials</td>
<td>CDM 255 Civil Drafting</td>
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<td>CDM 210 HVAC Drafting</td>
<td>CPM 220 3D Animation</td>
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<td>GEO 120 Introduction to GIS</td>
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**Choose from one History or Political Science course HIS 101, 102, 115, 270; POL 101 or 102.**

***The Academic Skills Assessment is required before enrolling in math or English courses. If a student places into lower level courses than are required for his/her degree, then the student needs to first enroll in lower level courses before enrolling in the courses needed for graduation.

The student earning a Certificate needs to be aware that the courses taken are specifically designed to help in obtaining employment, are not designed for transfer to a four-year institution. If the student wants to transfer courses, then the Associate of Arts Degree should be pursued.

For further details about this program, please contact department chairman David Niermann at 922-8561 or dniermann@stchas.edu.

05/11
Faculty & Staff Mini-Grants Application

All three parts of the grant proposal must be completed and submitted to the Foundation (ADM 1119) by 4 p.m. Oct. 29, 2010. Proposals are reviewed and funded once a year. Funding is available because individuals and businesses who believe in the power of education give to SCC!

<table>
<thead>
<tr>
<th>Part I:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Title:</td>
<td>MakerBot (&quot;A robot that makes things&quot;)</td>
</tr>
<tr>
<td>Category:</td>
<td>☑ Equipment ☐ Program ☐ Community Focus ☐ Other</td>
</tr>
<tr>
<td>Initiator and Department:</td>
<td>David Niermann, Pre-Engineering/CAD/General Technology Dept.</td>
</tr>
<tr>
<td>Proposed Start Date:</td>
<td>01/24/2011</td>
</tr>
<tr>
<td>Project Length:</td>
<td>Indefinite</td>
</tr>
<tr>
<td># Students Benefitting:</td>
<td>Approximately 200 (SCC) and 250 (regional high schools)</td>
</tr>
</tbody>
</table>
PART II: Project Overview

Please answer all the following questions. These questions are designed to assist you in organizing your proposal. (Add additional pages if necessary. Five page limit.)

It is recommended to have someone who knows nothing about the project read the entire proposal to be sure it makes sense. If Foundation Grants Committee members do not understand certain jargon, abbreviations, etc; they will not understand the value of the project being proposed.

Project: What is the scope of the project?

For an introductory scope, please refer to this 2-minute online video clip from the CBS Evening News...
http://www.youtube.com/watch?v=l5srGG012pU&feature=fvst ("The Rise of MakerBots")

Problem/Need: What is the need or problem that this project addresses?

The need for broad-based, engaging STEM (Science, Technology, Engineering, Math) activities that can attract and retain students in technical majors.

College Mission: How does this project fit the college mission?

Inspiration for life-changing decisions to pursue technical careers, provision of educational experiences and extra-curricular activities important for student success, and potential for frequent community interaction.

Goals and Objectives: How will the success of your project be measured?

The number of student participants, the number of community events, the number of design projects.

Resources: Is staff, space, or equipment available? If not, how will they be obtained?

Yes. Only a laptop computer and conventional electrical outlet are needed. Storage needs are minimal (one cabinet shelf). Proposed resources for build and upkeep are SCC Student Engineering Club members.

Sustainability: If applicable, how will the project be funded in the future? Is funding coming from others sources and if yes, what are those sources?

Future project funding may only involve minimal supply costs (<$100/year). Accessories such as a laptop computer and tools will be considered after initial use (current proposal is to use personal PCs and tools).
Part Ilia: Budget Summary

- One MakerBOT CNC Ultimate Kit $915.00
- Supply costs $ 50.00
TOTAL $965.00

NOTE: This proposal involves use of a laptop computer and tools (e.g. soldering kit, hand tools) that will be supplied by Student Engineering Club members. Programming is open-source, and it is likely that students using their own laptops will have the best opportunities.

Part Ilb: Supporting Materials

Project Summary

This type of machine is sometimes referred to as a “3D Printer”, “Rapid Prototyping Machine” or a “Computer Numerical Controlled Machine”. Basically, a computer programmed design can be made and used to make a seemingly endless array of plastic parts. Plastic input material is melted and precisely applied and solidified according to the design program.

Expanded Narrative

STEM (Science, Technology, Engineering, and Math) development has been recognized as increasingly critical for society success. The percentage of U.S. high-school graduates proceeding to college engineering studies has been on a downward trend over the last 20 years. Computerization has enabled more global competition and technology is evolving at a rapid pace.
This proposal involves a project that is broad-scoped. A wide variety of options exist for technical careers and work – a project that can resonate with many varied skills and interests would be ideal. This project involves building (from a kit), planning/organization, computer programming, upkeep/maintenance, design, production, and communication.

This proposal involves a project that is engaging. A demo unit was borrowed for the SCC “Fall Fun Blitz” and attracted a record number of students visiting the Student Engineering Club booth. This demo unit was also borrowed for an Engineering Club meeting, and the attendance was “standing room only” with unanimous club member agreement to seek funding. See photos below of our SCC Student Engineering Club activity with the borrowed demo unit.

This proposal involves a project that has great community interaction potential. Since the unit is portable, and only requires an electrical outlet and laptop computer, it can be taken outside the college for demonstration. The possibilities include demos at high schools, robotics competitions, special events (e.g. Engineers Day at the St. Louis Science Center), and professional organizations (e.g. various professional societies). The recruiting and marketing opportunities would be high, and would be enhanced by direct student involvement. It also has the potential for direct, tangible benefits for Foundation sponsors (e.g. build of company key chains, logos, etc.)
This proposal involves a project that is **accommodating**. Limited storage space exists at SCC, but the small size of this unit is very manageable. SCC does not have a shop or engineering laboratory currently, but this project can be set up in an ordinary classroom. Previous budget proposals for units costing $40,000 or more have not been accepted, but the low cost of this unit is affordable. This project can involve use at the student’s convenience without deadlines, thus will allow proper prioritization for studies. Since an endless number of projects can be developed, there will be no actual finish line and benefits should be indefinite. Open-sourced software will enable programming improvements to be gained real-time.

This proposal involves a project that provides **college service**. There are direct applications with 4 separate subject areas at SCC – Pre-Engineering, Computer Aided Drafting, Computer Science, and General Technology. In addition, the opportunity to provide physical products for other departments, clubs, and organizations exists.

This proposal involves a project that proactively **addresses future global trends**. Because of computerization, new designs are increasingly developed and simulated via computer programs as opposed to traditional physical build and testing in prototype shops. Math, science, and technical skill level demands will increase under these conditions as empirical methods will be declining. Global competition increases also under these conditions, and a STEM prepared workforce becomes of higher importance.
## CADD National Occupational Standards

### 1. Fundamental Drafting Skills

<table>
<thead>
<tr>
<th>Drifting Standard</th>
<th>Technical Drafting</th>
<th>CAD 1</th>
<th>CAD 2</th>
<th>CAD 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1. Drafting Skills</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.1.1. Use drafting media and related drafting materials (e.g., paper, vellum, marker, pens, tones, cartography)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.1.2. Use basic measurement systems (e.g., fractions, decimals, and metric measurements)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.1.3. Identify line styles and weights</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.1.4. Use metric and imperial units correctly</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.2. Orthographic Projections</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.2.1. Identify, create, and place appropriate orthographic views</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.2.2. Identify, create, and place appropriate auxiliary views</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.3. Pinhole Drawings</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.3.1. Identify and create pinhole drawings (e.g., hatched)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.3.2. Identify and create auxiliary drawings</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.3.3. Identify and create auxiliary section views</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.3.4. Dimensioning</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.4.1. Apply dimensioning rules correctly (e.g., mechanical drawings)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.4.2. Use correct dimensioning terminology (e.g., diameter)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.4.3. Dimension objects correctly (e.g., lines, angles, circles, curves, dimensions)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.4.4. Dimension complex shapes (e.g., spheres, cylinders, taper, conical)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.4.5. Dimension features of a center line</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.4.6. Dimension features of a center point</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.4.7. Use appropriate dual dimensional standards</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.4.8. Use see and not dimension practices</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.4.9. Use various dimensioning tools (e.g., conical, polar, distance, diameter)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.4.10. Use tolerance dimensions and geometric dimensioning and tolerancing (GDT) on drawings when appropriate</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tr>
</tbody>
</table>

### 2. Fundamental Computer Skills

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Technical Drafting</th>
<th>CAD 1</th>
<th>CAD 2</th>
<th>CAD 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.1. Demonstrate proper care of equipment</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.1.2. Demonstrate output device (e.g., mouse, keyboard)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.1.3. Operate and adjust input devices (e.g., pen, printer, plotter)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.1.4. Correct handling and operation of storage media</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.1.5. Correct monitor control for maximum comfort and usability</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.1.6. Use monitor and operate information service (e.g., electronic mail, bulletin boards, websites)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical and Safety Needs</th>
<th>Technical Drafting</th>
<th>CAD 1</th>
<th>CAD 2</th>
<th>CAD 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.1. Demonstrate ergonomic considerations (e.g., keyboard, mouse, position, lighting)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.2.2. Demonstrate ergonomic safety (e.g., electrical and mechanical hazards)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

### 3. Basic CADD Skills

<table>
<thead>
<tr>
<th>Skill</th>
<th>Technical Drafting</th>
<th>CAD 1</th>
<th>CAD 2</th>
<th>CAD 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1. Create</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.1.1. Create a new drawing</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.1.2. Perform design setup</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.1.3. Construct geometric figures (e.g., lines, splines, circles, and arcs)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.1.4. Create a circle using approximate style and size in an existing drawing</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.1.5. Use and control accuracy enhancement tools (e.g., entity positioning methods such as snap and grid)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.1.6. Identify, create, insert, and use approximate symbology libraries</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.1.7. Create and modify models</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.1.8. Create drawing objects (e.g., lines, circles, arcs)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.1.9. Create 2D geometry from 3D models</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.1.10. Create a pipe from 3D objects</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.1.11. Create 3D polylines from 2D geometry</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

### 4. Advanced CADD Skills

<table>
<thead>
<tr>
<th>Skill</th>
<th>Technical Drafting</th>
<th>CAD 1</th>
<th>CAD 2</th>
<th>CAD 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1. Create</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.1.1. Create a new drawing (e.g., a complex drawing)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.1.2. Create a new drawing (e.g., a complex drawing)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.1.3. Create and modify models (e.g., entity positioning methods such as snap and grid)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.1.4. Create and modify models (e.g., entity positioning methods such as snap and grid)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.1.5. Create and modify models (e.g., entity positioning methods such as snap and grid)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.1.6. Create and modify models (e.g., entity positioning methods such as snap and grid)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.1.7. Create and modify models (e.g., entity positioning methods such as snap and grid)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.1.8. Create and modify models (e.g., entity positioning methods such as snap and grid)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.1.9. Create and modify models (e.g., entity positioning methods such as snap and grid)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.1.10. Create and modify models (e.g., entity positioning methods such as snap and grid)</td>
<td>X</td>
<td>X</td>
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<td>X</td>
</tr>
</tbody>
</table>

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St. Charles Community College - Computer Aided Drafting
August, 2011

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MISSOURI DRAFTING COMPETENCY LIST

A. DRAFTING ROOM PROCEDURES
   1. Apply safety policies and procedures.
   2. Identify basic drafting terminology.
   3. Identify American National Standards Institute (ANSI) and International Standards Organization (ISO) standards and terminology.
   4. Identify drafting occupation and related fields and occupations.
   5. Apply recordkeeping procedures (files and record retrieval).
   6. Identify and apply ergonomic considerations.

B. TOOLS AND EQUIPMENT
   1. Select proper drawing instruments and equipment.
   2. Demonstrate proper use, care, and adjustment of drawing and computer equipment.
   3. Produce copies.
   4. Operate and adjust output devices (e.g., mouse, keyboard).
   5. Operate and adjust output devices (e.g., plotters, printers, data transfer).
   6. Identify and use data storage, retrieval, and back-up systems.
   7. Identify computer operating systems and procedures.

C. BASIC DRAWING SKILLS
   1. Lay out drawings.
   2. Construct transfer and blocks.
   3. Construct freehand sketches.
   4. Read and transfer (English and metric) measurements.
   5. Label technical drawings and diagrams.
   6. Demonstrate techniques in line construction (e.g., lineweights, linetypes).
   7. Construct a drawing with mechanical aids.
   8. Construct a drawing with technical aids.
   9. Perform basic geometric construction (e.g., angles, tangents, poligons, arcs).
   10. Identify and use various annotation methods.

D. ORTHOGRAPHIC DRAWINGS
   1. Identify use and application of orthographic drawings (3rd angle projection).
   2. Identify 1st and 3rd angle projection drawings.
   3. Identify and use of orthographic views projection.
   4. Isometric view drawings (3rd angle projection).
   5. Prepare orthographic drawings (3rd angle projection).

E. AUXILIARY VIEWS
   1. Identify use and application of auxiliary views.
   2. Construct primary auxiliary views.
   3. Construct secondary auxiliary views.

F. DESCRIPTIVE GEOMETRY
   1. Perform graphic solutions of points, lines, and planes.
   2. Solve true length of lines, bearing and slope of lines.
   3. Perform graphic solutions of solids.
   4. Perform graphic solutions of intersections (e.g., lines, planes, and solids).
   5. Construct drawings using the revolution method.

G. SECTIONAL VIEWS
   1. Identify and draw standard sectional views.
   2. Identify and draw sectional views.
   3. Identify and use cutting planes.
   4. Identify and use conventional symbols.
   5. Identify use and application of sectional views.

H. PICTORIAL DRAWINGS
   1. Identify use and application of pictorial drawings.
   2. Sketch pictorial drawings.
   3. Construct axonometric (e.g., isometric), oblique, and perspective drawings.

I. DIMENSIONING AND TOLERANCING
   1. Construct dimensioning objects.
   2. Identify and apply dimensioning practices.
   3. Identify and apply tolerancing.
   4. Identify and apply geometric dimensioning and tolerancing techniques.

J. APPLIED MATHEMATICAL SKILLS
   1. Apply basic, mathematical principles.
   2. Apply basic geometric principles.
   3. Apply basic trigonometric principles.
   4. Solve problems using formulas.

K. BASIC CAD SKILLS
   1. Create new 2D drawings.
   2. Perform drawing setup to applicable standards (i.e., settings, layers, lineweights, and linetypes).
   3. Identify and use view and display commands (i.e., zoom, pan, view, section, rotation).
   4. Use Inquiry commands to extract drawing data (i.e., entity characteristics, distances, areas, text).
   5. Edit, copy, and manipulate drawing entities (i.e., properties, trimming, scaling).
   6. Use annotations to show drawing.
   7. Use and change dimensioning variables.
   8. Letter and add text.
   9. Plot drawing to proper scale.
   10. Identify backup and archival methods.
   11. Identify drafting and archival methods.
   12. Identify and apply layering techniques.
   13. Identify methods of showing drawing (i.e., draft views).

L. ADVANCED CAD SKILLS
   1. Create 3D drawings using extrusion and sweep tools.
   2. Create surface and solid models.
   3. Create jointed and offset surfaces.
   4. Edit solids, curves, and surfaces.
   5. Create 3D geometry from 2D models.
   6. Import and export various file formats (e.g., DXF, DWT, IFC).
   7. Extract geometric and attribute data (i.e., part/assembly and component information).
   8. Perform intersection to improve productivity.
   9. Install and configure software.
   10. Install and configure hardware.
   11. Extract surface and mass properties (e.g., area, perimeter, moments of inertia, centroids).
   12. Develop geometry using parametric programs.

M. INTRODUCTION TO ARCHITECTURAL DRAWINGS
   1. Construct architectural symbols.
   2. Identify architectural design and planning principles.
   3. Identify basic construction terminology and materials.
   4. Produce site plan.
   5. Identify applicable building codes.
   6. Produce a schedule.
   7. Produce and draft an as-built floor plan.
   8. Produce typical wall and building sections with necessary details.
   9. Produce floor plans.
   10. Produce elevation drawings.

N. INTRODUCTION TO RESIDENTIAL AND COMMERCIAL WIRING DRAWINGS
   1. Identify electrical symbols.
   2. Identify applicable codes (e.g., NEC, IBC, and SST).
   3. Produce wiring schematics.

O. INTRODUCTION TO ELECTRONIC DRAWINGS
   1. Identify electronic symbols.
   2. Produce electronic schematics and diagrams.

P. INTRODUCTION TO PIPING/PLUMBING DRAWINGS
   1. Identify symbols, fittings, fixtures, and valves.
   2. Identify applicable codes.
   3. Identify principles of pneumatics and hydraulics.
   4. Produce orthographic drawings.
   5. Produce isometric drawings.

Q. INTRODUCTION TO STRUCTURAL STEEL DRAWINGS
   1. Identify structural steel shapes.
   2. Identify applicable codes (e.g., CSA, AISI, SI, and B360).
   3. Identify and applied welding symbols.
   4. Identify open web joist type and applications.
   5. Produce a steel framing plan (drawing).
   6. Produce a detail and assembly (including beam connections) with bill of materials.
   7. Draw simple connectors.

R. INTRODUCTION TO PRODUCTION MANUFACTURING DRAWINGS
   1. Identify use and application of finish and detail symbols (e.g., bolts, pins, tags).
   2. Identify manufacturing processes (e.g., machine processes, metal forming, CNC).
   3. Produce detail drawings applying standard machine fits, tolerances, and symbols.
   4. Produce machine assembly drawing.
   5. Apply standard fits, finishes, and tolerances to machine drawing.
   6. Develop a parts list.
   7. Produce drawings for weldable component parts.
   8. Produce drawings for metal bending and shopfitting drawings.
   10. Produce drawings for CAD/CAM applications.
   11. Produce drawings for cam.
   12. Produce drawings for gears.

S. INTRODUCTION TO CIVIL/GIS (GEOGRAPHIC INFORMATION SYSTEM) DRAWINGS
   1. Identify symbols.
   2. Identify use of GIS and GPS (global positioning systems).
   3. Produce a contour plan.
   4. Produce a profile drawing.
   5. Produce a land survey plan from written description.

T. INTRODUCTION TO METAL/WELDING DRAWINGS
   1. Identify metal symbols (e.g., ASTM).
   2. Produce representative metal drawings.
   3. Identify sheet metal layout procedures.
   4. Identify welding symbols.
   5. Produce sheet metal drawings for CAD/CAM applications.
   6. Produce metal/structural plans.
MID RIVERS TECH PREP CONSORTIUM
ARTICULATION AGREEMENT

CERTIFICATE OF CREDIT

Between
Francis Howell, Francis Howell North,
and Francis Howell Central High Schools

and

ST. CHARLES COMMUNITY COLLEGE
Accounting, Business, CAD, Computer Science, and
Business Administrative Systems

St. Charles Community College has agreed to grant college credit to students completing the courses in the Business and Office Education Programs at Frances Howell, Francis Howell North, and Francis Howell Central High Schools according to the matched listing below.

<table>
<thead>
<tr>
<th>Francis Howell, Francis Howell North, and Francis Howell Central High Schools</th>
<th>SCC Matching Credit Allowance</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboarding/Word Processing (1 year)</td>
<td>BAS 101 Keyboarding</td>
<td>3</td>
</tr>
<tr>
<td>Supervised Business Experience or Business Technology (1 year)</td>
<td>BAS/CPT 103 Microcomputer Applications</td>
<td>3</td>
</tr>
<tr>
<td>Supervised Business Experience or Business Technology (1 year)</td>
<td>BAS 160 Word Processing – WORD</td>
<td>2</td>
</tr>
<tr>
<td>College Notetaking/Superwrite</td>
<td>BAS 140 Note Taking</td>
<td>3</td>
</tr>
<tr>
<td>Introductory Accounting</td>
<td>ACT 101 Applied Accounting</td>
<td>3</td>
</tr>
<tr>
<td>Advanced and Automated Accounting</td>
<td>ACT 110 Financial Accounting</td>
<td>4</td>
</tr>
<tr>
<td>Introduction to Business and Introduction to Business Enterprise or Personal Finance and Money Management</td>
<td>BUS 101 Introduction to Business</td>
<td>3</td>
</tr>
<tr>
<td>Marketing I (2 semesters) and Marketing II (2 semesters)</td>
<td>BUS 230 Principles of Marketing</td>
<td>3</td>
</tr>
<tr>
<td>CAD I (Updated 1/08)</td>
<td>CDM-103 Introduction to CAD Systems</td>
<td>2</td>
</tr>
<tr>
<td>CAD II (Updated 1/08)</td>
<td>CDM 104 CAD Systems II</td>
<td>3</td>
</tr>
<tr>
<td>Residential Architecture (Updated 1/08)</td>
<td>CDM-205 Architectural Drafting I</td>
<td>3</td>
</tr>
</tbody>
</table>

Student Instructions: To obtain credit for course work on the St. Charles Community College (SCC) transcript, the following course work and procedures must be completed within three years of high school graduation:

- All high school course work being articulated must be with a grade of B or better.
- These articulated credits have been designed for dual credit at your high school and for credit at SCC towards an Associate of Applied Science Degree and not for the Associate of Arts (transfer) Degree.
- Request that your high school send an official copy of your transcript to the Office of the Registrar at St. Charles Community College.
  - Complete an application form for SCC and send to SCC Admissions Office.
- When meeting with SCC counselor/advisor or registrar, identify yourself as a Tech Prep Articulation student.
  - Present your white copy of this Tech Prep Certificate and complete your registration for classes for the first semester.
- Should you wish to transfer any of these articulated credits from SCC to another college or university, please check with a counselor/advisor at transfer institution to make sure they will approve the transfer of these articulated credits.