

# **PUGET SOUND CONSORTIUM FOR MANUFACTURING EXCELLENCE**

## **2004-2005 Evaluation Report**

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### **BACKGROUND**

The Puget Sound Consortium for Manufacturing Excellence (PSCME) is an education-industry partnership working towards building the connection between manufacturing technology education, student career goals, and private sector demand. In its fourth year, the PSCME is working to solidify its legacy in manufacturing technology education by ensuring the sustainability of the programs and processes developed during the funding period.

The PSCME has three program objectives:

Objective 1: Deploy a manufacturing technology curriculum that will allow graduates of manufacturing programs to meet national skill standards. Provide realistic assessments for each module within the curriculum.

Objective 2: Promote professional development of high school instructors, college faculty and manufacturing trainers by providing high quality instruction on the use and application of PSCME instructional products.

Objective 3: Review opportunities for certification programs and enhanced articulation between secondary and post-secondary schools; provide examples of careers and career paths in manufacturing for teachers and students.

Objective 4: Develop programs for dissemination of our curriculum and for program sustainability.

### **EVALUATION OF ACTIVITIES IN YEAR FOUR**

In its final year, PSCME is working toward the completion of its objectives. Therefore, the major evaluation question was: To what extent has the program reached its objectives? In the following sections, evaluation findings will be described in relation to program objectives.

**Objective 1: Deploy a manufacturing technology curriculum that will allow graduates of manufacturing programs to meet national skill standards. Provide realistic assessments for each module within the curriculum.**

The PSCME has partnered with the Manufacturing Technology Advisory Group (MTAG) in the revision and implementation of core curriculum modules. In year 3, the program's National Visiting Committee recommended that "learning outcomes are measurable and student learning can be assessed." To this end, evaluation activities focused on obtaining the results of student assessments. Student assessment

rubrics were added to each module and were to be used by teachers piloting the curriculum. The following sections report outcomes for curriculum development activities.

### **Shorewood High School, Shoreline, Washington**

Shoreline Community College and PSCME established a relationship with Shorewood High School, a nearby school that could be used as a pathway for students entering manufacturing programs at the community college. The instructor, John Holmes, was newly hired and placed in charge of a classroom for the first time. The partnership agreement stated that all modules would be piloted during the academic year and that student assessment results would be returned to the program. Shorewood High would receive \$500 for a field trip for students, and any student who finished the class with a “B” average would receive 5 college credits from Shoreline Community College.

In the fall of the academic year, the evaluator interviewed John Holmes. During the interview, John mentioned that he had been a machinist for 12 years, is a retired Marine, and currently works part time for a machine shop in the area. John volunteered during the previous school year in Shorewood High’s automotive classes and is now a certified teacher in Washington State. He stated that teacher enthusiasm is important for classroom success, and he mentioned that he has invited students to his shop to see real-world machining and manufacturing.

The MTAG/PSCME modules are the only curriculum John is using in his class this year, with no supplementary materials from other resources. At the beginning of the year, John estimated that it would take the whole year to complete all of the modules. At the time of the interview, he had already taught Interpersonal Effectiveness, Introduction to Manufacturing, Safety in Manufacturing, and Applied Mathematics modules. John suggested revising the Interpersonal Effectiveness module as his students were restless, did not pay attention during the activities, and wanted hands-on materials. John was testing and grading students for each module and agreed to provide that information to PSCME.

### **Shorewood High School Pre-Survey**

At the start of the school year, Shorewood High School students who were enrolled in John Holmes’s class completed the PSCME Pre-survey (see Appendix A). The purpose of the survey was to gain an understanding of students’ current knowledge of manufacturing, to assess the needs of students more accurately, and to design the class in a way that will better accommodate student goals, interests and backgrounds. All 22 students completed the survey. A post-survey will be administered in June 2005.

The majority of students reported that they were either in the 10<sup>th</sup> or 11<sup>th</sup> grades (82%) and self-identified as White/Caucasian (77%), Native American (5%), Asian (5%), or Other – identified as Russian and Greek (14%). All students in the class were males.

It appears that students have very little background in math and science courses upon entering. When asked to report the classes they have completed, students reported first or second year courses, and no advanced or upper-level classes. Results are shown in Table 1.

**Table 1. Courses Completed by Shorewood High School Students.**

Science	Math	
9th grade Science (72.7%)	Integrated Math 1A (72.7%)	Integrated Math 1B (31.8%)
Biology 1 (36.4%)	Integrated Math 2A (27.3%)	Integrated Math 2B (13.6%)
Biology 2 (4.5%)	Integrated Math 3A (4.5%)	Integrated Math 3B (4.5%)
	Integrated Math 2AH (4.5%)	Integrated Math 2BH (4.5%)
	Integrated Math 3AH (4.5%)	Integrated Math 3BH (4.5%)

A little over half of the students stated that they would be going to college full time after high school, with one fourth of the students attending college part time, and almost 20% of the students entering the Armed Forces. Almost half of the students planned to attain a Bachelors degree, and 18% said they would like to get a Masters. When presented a list of common college majors, the top two choices were for Engineering (e.g., aerospace, civil engineering, electrical engineering, industrial engineering, mechanical engineering, other engineering) and Manufacturing (e.g., materials science, composites, technology).

Students were also asked about their concerns and expectations for the class; Table 2 presents students' responses. Students did not seem to be too concerned about class requirements. Instead, they thought the class would be more fun than traditional classes and that it would help them get a job.

**Table 2. Shorewood High School Students' Concerns and Expectations.**

Please tell us how much you <b>agree</b> or <b>disagree</b> with the following statements by marking one number for each.	DISAGREE		AGREE	
	Strongly 1	A Little 2	A Little 3	Strongly 4
1. I am concerned about being able to complete the class requirements.	MEAN = 2.05; SD = .92			
2. I am worried that I will not understand the math involved in the class.	MEAN = 1.95; SD = .80			
3. I am worried that I will not understand the science involved in the class.	MEAN = 2.10; SD = .77			
4. I plan to study or work in manufacturing after completing high school.	MEAN = 2.71; SD = .64			
5. I think that participation in this class will help me get a job.	MEAN = 3.33; SD = .58			
6. I expect this class to be an "easy A."	MEAN = 2.52; SD = .81			
7. I think this class will be more fun than traditional classes.	MEAN = 3.57; SD = .60			

Students were also asked to describe their ability levels for skills related to class activities (see Table 3). Overall, students reported intermediate ability in math and science, somewhat lower ability in engineering, manufacturing, and hands-on manufacturing processes. Technology skills received a range of responses – from beginner to advanced. Students were fairly confident of their problem solving skills.

**Table 3. Shorewood High School Students' Abilities.**

<b>SECTION 3</b>			
How would you describe your ability level for each of the following?	Beginner 1	Intermediate 2	Advanced 3
Math Skills	13.6%	68.2%	18.2%
Science Skills	13.6%	77.3%	9.1%
Engineering Skills	59.1%	40.9%	0%
Technology Skills	31.8%	45.5%	22.7%
Manufacturing Skills	50.0%	50.0%	0%
Problem Solving Skills	9.1%	54.5%	36.4%
Skills in Hands-on Manufacturing Processes	36.4%	50.0%	13.6%

Students were asked three knowledge questions from the Introduction to Manufacturing module. Almost all students answered all three questions correctly. Finally students were asked to respond to two open-ended questions concerning what they hoped to learn in the class and their greatest concerns. Students responded:

1. What do you hope to learn by participating in the course?
  - How to work with metal and use machinery (59%)
  - Skills to get a job (32%)
  - Make cool stuff (5%)
  
2. What is your greatest concern about participating in the course?
  - Failing/not understanding (23%)
  - Learning what we need to get a job (14%)
  - Getting hurt (9%)
  - Doing it/welding (9%)
  - Getting to the college/conflict with schedule (9%)
  - Won't like it (5%)
  - Won't make anything (5%)

## Follow-up Teacher Interviews

To evaluate outcomes and progress, interviews were conducted in February 2005 with educators who have either purchased the MTAG/PSCME modules or who have been testing the modules during the current school year. The goal of this process was to document use of the modules in classrooms, and to provide information that will help PSCME and MTAG fine-tune processes.

### *Overview of Sites*

- **West Sound Technical Skills Center** instructor Bob Ramirez (3 years teaching experience) reports that his program is in “evolution” and that he uses MTAG/PSCME modules at every opportunity. The modules supplement the current textbook-driven curriculum that is written above the educational level of his students.
- **SeaTac Occupational Skills Center** instructor Rich Marshall reports that he is not using the MTAG/PSCME modules as written, but is using parts of the modules and incorporating them into his program. He feels that his instruction already covers the same materials, but in different ways.
- **Oak Harbor High School Technology Program** (Automotive Technology, Construction Technology, Electronics, Engineering, Metal Design) instructors are not using any of the MTAG/PSCME modules. Teachers feel that MTAG/PSCME modules provide basic instruction and their current curriculum covers advanced levels. The instructors have developed a grid to demonstrate how their courses meet MTAG competencies.
- **Anacortes High School** instructors Val Boyce and Mike Beemer tested MTAG/PSCME modules last year and are integrating them into the curriculum this year. The school is currently developing a Manufacturing Pathway Program.
- **Auburn School District** – repeated calls/emails but no return contact.
- **Shorewood High School** first year teacher John Holmes is using MTAG/PSCME modules as the only curriculum for his class. The instructor feels that it will take the entire school year to teach all of the MTAG modules.

### *Findings from the Interviews*

- **Instruction varies from exclusive use of MTAG/PSCME modules to no use.** Use of the modules may be related to 1) instructor experience, with novice teachers more likely to use modules as written, and 2) curriculum needs, with modules supplementing existing curriculum.
- **No sites are currently using student assessments and scoring rubrics as written in the modules.** Teachers seem to be using their own grading methods.

- **Instructors are more focused on meeting the MTAG competencies than teaching the modules.** Teachers believe the goal is that students acquire the skills. If students receive a grade of B or better in their courses, teachers think students have met the MTAG competencies.
- **Public school curriculum is based on the frameworks of Washington State** and has been approved by the Office of the Superintendent of Public Instruction (OSPI). For public schools, MTAG/PSCME modules need to match State requirements or MTAG must create agreements with the State.
- **MTAG/PSCME Modules are set up in the industrial model** and teachers feel schools are not set up in the same manner. Students want to take something home to show what they have done in class.
- **Students and their families do not know what MTAG is or what MTAG means.** Parents must see a need for a MTAG Certificate for it to matter to them.
- **Most schools articulate with local community colleges through Direct Transcript Agreements** (students receive college credit for high school courses without paying tuition; transcripts of courses taken are mailed from the community college directly to the student's home). Students in some schools receive college credit for completing coursework related to MTAG competencies.

#### ***Suggestions Given to MTAG and PSCME***

- **PSCME/MTAG must work with local businesses.** When businesses advertise for jobs, the job description should state they are looking for someone with a *MTAG Certificate*. Currently, teachers' recommendations for jobs carry more weight than a MTAG Certificate does. There may be a need for a "MTAG North" to work with businesses north of Seattle.
- **PSCME/MTAG should bring teachers and businesses together.** Local businesses need to know the teachers and what goes on in schools. Teachers need support from businesses. PSCME/MTAG could provide guest speakers, especially female speakers, for their classrooms and could provide support for student internships and field trips.
- **MTAG Certificate processes need to be in place.** Some teachers thought they understood that MTAG had a final test for competencies, but that students would have to pay for it and go somewhere else to take it. Teachers did not think this was feasible. How will students show they have met the MTAG competencies and attained a Certificate?
- **Articulation agreements need to be established.** Teachers would like all Washington State colleges to agree to give students credit for completion of MTAG-related coursework. It was suggested that PSCME/MTAG take the lead on this issue.

## **Site Visits to Schools**

In Spring 2005, the evaluator visited two schools, Oak Harbor High School and Anacortes High School, to review their use of MTAG/PSCME modules, ascertain if student assessment data was collected, and gather teachers' suggestions for use of the modules in classrooms.

### ***Oak Harbor High School, Oak Harbor, Washington***

Meetings were held with the Director of Career and Technology Programs and all five teachers who work in the program.

#### **Background**

- Oak Harbor High School (OHHS) Technology Program includes: Automotive Technology, Construction Technology, Electronics, Engineering, Metal Design.
- Five teachers each have 5 classes of about 25 students (approximately 625 students in the program per semester).
- Each program has an Industry Advisory Committee.
- OHHS participates in articulation with 4 community colleges (Everett, Edmonds, Shoreline, and Skagit Valley) through the Direct Transcript Agreement (transcripts of courses taken are mailed from the community college directly to the student's home; students receive college credit without tuition fees).
- About 1/3 of their students go on to community college after high school.
- Females make up less than 1/3 of the students in their classes.
- Students in their programs have a range of skills.
- Students in their classes are "good with their hands and want to be active."
- At OHHS Tech Prep is considered "Non-Essential" – the high school is moving to Academies, with only "academics" including higher order thinking.

#### **Curriculum**

- Oak Harbor High School technology curriculum is based on the frameworks from Washington State and has been approved by Moe Broom at the Office of the Superintendent of Public Instruction (OSPI).
- Since OHHS curriculum meets Washington State requirements, MTAG needs to match State requirements or create agreements with the State.
- OHHS added units to their overall curriculum design to meet MTAG competencies.

- If students receive a grade of B or better in OHHS curriculum, teachers feel students have met the MTAG competencies.

### **MTAG/PSCME Modules**

- Teachers felt that the goal is that students acquire the skills, not that the teachers do the modules.
- Teachers feel that their current curriculum goes beyond MTAG/PSCME module activities.
- Teachers did not want to put their lessons aside to do the MTAG/PSCME modules. They are meeting the competencies in other ways.
- Teachers feel that MTAG/PSCME modules might be useful for novice teachers.
- MTAG becomes just another thing for which teachers have to meet requirements.
- MTAG/PSCME modules are set up in the industrial model format – schools are not set up that way – schools work differently. Students want to take something home, want to show what they have done, what is theirs.
- Teachers thought that MTAG had a final test for competencies. Students would have to pay for it and go somewhere else to take it. Teachers thought this was unlikely.

### **MTAG Program and Certification**

- Students do not know what MTAG is or what MTAG means.
- Parents must see a need for MTAG Certification for it to matter.
- MTAG needs to get businesses on board – when businesses advertise for jobs, the description should say they are looking for someone with MTAG Certification.
- Teachers' recommendations for jobs carry more weight than MTAG Certification.
- Businesses will train employees if they do not have the skills.
- MTAG should provide money for field trips to take students to colleges and industry sites, schools need money for lunches, to pay for substitutes, and for the bus (\$300 just for the bus) – Teachers felt they were “held hostage” for field trip money. If they did not Beta test the materials, they could not get money for field trips.
- MTAG could provide guest speakers. Teachers are looking for guest speakers for their classrooms, especially female speakers.
- MTAG could provide support for student internships.

- Students need to see what is in the real world.

### **Careers**

- OHHS meets with 8th grade students' parents to market manufacturing/technical careers.
- OHHS assembles a portfolio of information on careers that they give to students.
- Jobs are changing and families need to know this.
- The program wants to adapt to the changing needs of the local manufacturing community.
- Oak Harbor families usually want their children to stay in the community after high school.
- OHHS would like copies of the PSCME video developed by MOHAI.

### **Suggestions**

- PSCME should look at how schools developed their programs and what coursework they have included to meet MTAG Certification.
- Bring teachers together to discuss options and plan curriculum and articulation.
- Teachers need a video on manufacturing careers – the video must be exciting to students and families.
- MTAG must work with local businesses. There may be a need for a “MTAG North.”
- Teachers and manufacturers need to get together – local industries need to know the teachers and what goes on in schools.
- Teachers would like to get all Washington colleges (not just those that OHHS articulates with) to agree to give students credit at whatever college they attend. Teachers perceive that there seems to be conflict between the colleges.
- Teachers need support.

### ***Anacortes High School, Anacortes, Washington***

Meetings were held with the Director of Career and Technology Programs and the two teachers who piloted MTAG/PSCME modules in their classrooms.

## **Background**

- Marge Thomas, the Director of the Career and Technology Program at Anacortes High, is a dynamic, organized, and competent leader.
- Community business owners are on Advisory Committees/Boards for each program and come to the school to provide support for classes.
- Anacortes, Washington, is located on the edge of Puget Sound, so many marine technology businesses are located in the area. Anacortes also has a nearby refinery that is a major employer in the region.
- Two teachers are using the Modules: Val Boyce (owned a manufacturing business for 28 years, has been teaching welding and metals for 3 years); Mike Beemer (owns a marine technology business and has been teaching for 5 years)
- There are approximately 1000 students in the Technology Program at the high school, which also includes business technology. Most students are white. The Director feels that gender representation is evenly split between males and female in the program.
- Most students go on to community college – usually at Bellingham Technical College or the Skagit Valley Community College.
- In a recent school review, students in the Technology program scored at higher levels on Bloom's Taxonomy than students in other programs. The Director feels the reason for this accomplishment is the time devoted to problem solving in classroom activities.
- There are formal articulation agreements with area community and technical colleges. This past year, 217 Anacortes High students earned 956 college credits. Many students also receive scholarships.

## **Curriculum**

- Teachers and the Director keep pace with curriculum advancements by attending conferences and meetings. When Marge Thomas finds something interesting, she brings the information to the group and to the Advisory Boards.
- Moe Broom, from the Office of the Superintendent of Public Instruction, recently audited the Anacortes Technology Program and felt that the school was ahead of larger districts.
- In a recent tally of students who wanted to enroll in metals class with Val Boyce, 191 students in the school noted that this class was their first choice. The class is overenrolled.
- Many times, more students want to take technology classes than the school offers.

## **MTAG/PSCME Modules**

- MTAG/PSCME Modules are taught in welding, metals, applied math, and marine technology classes.
- Teachers adapt curriculum as needed in their classrooms and feel that the modules fit their course goals.
- Teachers seem to appreciate module instructional strategies that encourage hands-on, real world processes.
- The Precision Measurement module was viewed favorably. The teacher noted that the calipers used in the module are outdated.
- The Shop Skills module was also viewed positively. The teacher mentioned that he uses the same tools in his classroom and conducts the proficiency testing.
- The Safety module seemed to be very valuable to the teacher. He uses most of the module “as is” without having to adapt anything for the classroom.
- The Applied Math module is used in all four sections of the Applied Math course offered at the school.
- The Marine Technology class uses parts of Shop Skills, Precision Measurement, Interpersonal Skills, and Career Exploration modules.
- Teachers liked the fact that the curriculum was developed for students in their classrooms and convey that information to them.
- Teachers use a few of the assessments, but not all, and usually adapt/integrate the assessments to fit their needs.

## **MTAG Program and Certification**

- Teachers did not seem to be concerned about MTAG Certificate requirements.

## **Careers**

- Anacortes High School has a yearly career fair that emphasizes career pathways.
- All sophomores are required to take a career course (a requirement for graduation) in which they explore the skill requirements and economics of the career, and also participate in job shadowing.
- Seniors are required to form a committee to review their Senior Project. Many times, committee members are local business owners.

- Speakers are invited into classrooms to provide information about careers – one teacher arranged for 30 speakers this past year.
- Anacortes has networks of businesses that are involved with the schools.
- High school counselors also go into the field to learn more about careers in growing fields.

### **Suggestions**

- One teacher wondered why MTAG does not have a module for automotive technology.
- One teacher suggested that K-20 modules for Marine Technology should be developed.
- It was suggested that NSF support a consortium around Marine Technology.
- One teacher is hoping to get a Marine Technology Center in Anacortes, which would use composites to build boats.

## Student Assessment of Learning

At the time of this report, we have received only one module assessment rubric from Shorewood High School. The teacher taught the Shop Skills module, results are reported in Table 4.

**Table 4. Shorewood High School – Shop Skills Module (N = 13, 100% Male Students).**

Hand-tool Project				
1 = Demonstrates poor understanding of core concepts	2 = Demonstrates limited understanding of core concepts	3 = Demonstrates good understanding of core concepts	4 = Demonstrates excellent understanding of core concepts	MEAN (SD)
0%	30.8%	53.8%	15.4%	2.85 (.69)
Written Safety Tests				
1 = Demonstrates poor understanding of core concepts	2 = Demonstrates limited understanding of core concepts	3 = Demonstrates good understanding of core concepts	4 = Demonstrates excellent understanding of core concepts	MEAN (SD)
0%	7.7%	46.2%	46.2%	3.38 (.65)
Hands-on Safety Tests				
1 = Demonstrates poor understanding of core concepts	2 = Demonstrates limited understanding of core concepts	3 = Demonstrates good understanding of core concepts	4 = Demonstrates excellent understanding of core concepts	MEAN (SD)
0%	7.7%	46.2%	46.2%	3.38 (.65)
Pin Vise Project DID NOT HAVE TIME FOR THIS PROJECT – NO SCORES				
1 = Demonstrates poor understanding of core concepts	2 = Demonstrates limited understanding of core concepts	3 = Demonstrates good understanding of core concepts	4 = Demonstrates excellent understanding of core concepts	MEAN (SD)
Class Participation				
1 = Demonstrates poor understanding of core concepts	2 = Demonstrates limited understanding of core concepts	3 = Demonstrates good understanding of core concepts	4 = Demonstrates excellent understanding of core concepts	MEAN (SD)
0%	30.8%	7.7%	61.5%	3.31 (.95)
Total Score				
1 = Demonstrates poor understanding of core concepts	2 = Demonstrates limited understanding of core concepts	3 = Demonstrates good understanding of core concepts	4 = Demonstrates excellent understanding of core concepts	MEAN (SD)
0%	23.1%	38.5%	38.5%	3.15 (.80)

From a review of the teacher's comments on the rubric assessment sheets, it seems as if learning outcomes may be closely related to behavior in the classroom, with students who misbehave scoring lower on the instrument. Additional assessment rubrics are needed to monitor this finding.

The Shorewood High School teacher also reported the following grades for students (Table 5), although no module assessment rubrics were delivered.

**Table 5. Shorewood High School Module Scores**

Student Numbers	Intro to Manufacturing 9/15/04	Safety 10/4/04	Interpersonal Effectiveness 10/22/04	Applied Math 10/29/04	Precision Measuring 11/1/04	Interpreting Technical Drawing 12/10/04	Overall Grade
1	A+	A+	A-	A+	A+	A-	A
2	B+	A	B	B+	B	B	B+
3	A-	A	A-	B+	B	B-	B+
4	A	A+	A-	A	B+	A	A
5	A-	B+	B	B	A	B	B+
6	A-	A-	A	B-	A-	A-	A-
7	A-	B+	B	B	B+	B	B+
8	A	A-	A-	A-	B+	A-	A-
9	A	A	A-	A-	A	A	A
10	B+	A-	A-	B+	A-	B+	A-
11	B+	A-	A	B	B+	A	A-
12	A-	A-	A-	A	B	B+	A-
13	A-	A	A	A-	B	A-	A-
14	A-	A	A-	A	A	A-	A
15	A-	B+	B	B+	B+	B+	B+
16	B-	B	F	C+	C+	F	F
17	B+	B+	B-	B+	C+	B+	B
18	A-	B+	A-	B	B	B	B+
19	A	A-	A-	B+	B+	A-	A-
20	A	A+	B	A-	B+	B	A-
21	A-	B+	B-	B+	B	B	B

Renton Community College and Lake Washington Technical College also piloted modules and provided feedback to PSCME. The Renton report is included in Appendix B. Instructors made suggestions for improvement for each module, which were provided to the PSCME PI and curriculum development staff.

**Other Assessment Activities**

PSCME staff is currently working with MTAG on the design of a final written assessment for students, a requirement to receive the MTAG certificate. Since teachers are using the modules in various ways – entire module to sections of a module – it is important to have a final written assessment of attainment of skill standards. An inquiry-based activity has also been developed as part of a final assessment. Students work as a team on a Catapult Activity, which is observed by MTAG-trained personnel.

An online method for collecting student assessment information and instructor comments for improvement has been developed by PSCME and will be used in the future.

## **Objective 2: Promote professional development of high school instructors, college faculty and manufacturing trainers by providing high quality instruction on the use and application of PSCME instructional products.**

In Fall 2004, PSCME staff presented information about the modules to teachers in school districts North of Seattle. The area is currently organizing a manufacturing consortium through industry-school partnerships. Oak Harbor and Anacortes High School teachers were in attendance and were recruited to beta test MTAG/PSCME modules. Teachers were asked to use the modules, provide feedback, and return the student assessment rubrics. For their assistance, schools would be receive funds to take students on a field trip to local industries.

Also during the academic year, PSCME staff worked closely with the instructor at Shorewood High School. As a novice teacher, he was experiencing difficulties in the classroom which affected implementation of MTAG/PSCME modules. Classroom organization, instructional objectives, and management strategies were emphasized. The instructor was paid by PSCME for 5 hours per week of planning time. Weekly meetings with the instructor were planned, but sometimes did not occur. As part of the agreement, the instructor was to complete module assessments and share them with PSCME. Some student assessment rubrics were returned to PSCME for analysis and others were not for a variety of reasons (i.e., lost, stolen).

### **Planning schedule for John Holmes, Manufacturing Instructor at Shorewood High School**

John Holmes is to spend 5 hours/week at Shoreline Community College, working with Gary Hansen to familiarize himself with the equipment and prep for his class sessions in the shop, and 5 hours a week working with John King (PSCME) to plan for classroom-based lessons and activities.

1) Weekly plans to focus upon:

- Specifying learning objectives, instructional materials, and classroom management goals and strategies for each class session.
- Identifying and scripting “flash points” within each lesson where John anticipates potential confusion or loss of student focus.
- In addition, a “learning hook” (heightening student interest and explaining the purpose of learning activities and how they relate to and build on students’ prior learning) and “closure” (a metacognitive review of what was learned, how it was learned, and what value it holds for students’ future educational and occupational goals) will be developed to introduce and close individual lessons and each module.

2) Planning is also to include organizing two field trips, one to John’s current employer and one to a MTAG company early in the second semester.

- The Manufacturing Field Trip Module will be used to guide the planning for both field trips in order to ensure a hands-on activity is provided within each site, specify and communicate

expectations for student learning during the field trips, and ensure all logistical arrangements are addressed in advanced.

3) Planning to include a review of prior weeks' student learning and engagement, culminating in the completion of student assessment rubrics for each module.

### **Master Teacher Workshop**

A workshop for teachers is being planned for June 2005. The purpose of the workshop is to help a core group of manufacturing educators develop skills, relationships, and a coherent vision for how they will work with MTAG to support and improve manufacturing education in western Washington. The workshop will involve discussion and reflection upon teachers' experiences working with the MTAG curriculum, sharing other best practices from their own teaching, evaluating module feedback and learning to make curricular revisions/extensions, assessing capstone activities and instruments, and planning for future training workshops. Five to seven teachers will attend and will form the group of Master Teachers who will interface with MTAG.

**Objective 3: Review opportunities for certification programs and enhanced articulation between secondary and post-secondary schools; provide examples of careers and career paths in manufacturing for teachers and students.**

PSCME has provided assistance to three high schools for field trips to local industries and community colleges. Students will complete the Field Trip Survey (Appendix C) at the conclusion. The first field trip was held mid-May, with the others soon to follow.

**Oak Harbor Field Trip Survey**

Oak Harbor High School staff and teachers planned their field trip so that students could see people working in the “real world” in order to gain an understanding of careers and what further education students will need. Students were able to visit Skagit Valley Community College and see the Marine Technology Program, where the instructor talked to them about the importance of training and preparation for a career. They also visited Nordic Tug and Dakota Creek Industries, local commercial manufacturing businesses. Students observed carpentry and welding work, and were informed of environmental and safety concerns of businesses today. At the end of the field trip, the students were asked to complete a Field Trip Survey. Although thirty-seven students were reported as having attended, only thirty-five students (1 female and 34 males) completed the survey. Results are shown in Table 6.

**Table 6. Oak Harbor High School Student Field Trip Survey Responses.**

Items	Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)	Mean	Standard Deviation
I like to learn about manufacturing jobs.	0.0	0.0	82.4	17.6	3.18	0.39
I am interested in a career in a manufacturing field.	0.0	35.3	38.2	26.5	2.91	0.79
I know the required qualifications for a job in manufacturing.	0.0	17.6	58.8	23.5	3.00	0.65
I could work in any of the work environments we saw today.	2.9	37.1	45.7	14.3	2.71	0.75
I might want to be a manufacturing technologist one day.	2.9	26.5	52.9	17.6	2.86	0.74
I might want to be an engineer one day.	5.9	14.7	58.8	20.6	2.94	0.78
Today I learned about my responsibilities as an employee.	2.9	11.4	71.4	14.3	2.97	0.62
Today I learned about required skills for a variety of jobs.	2.9	2.9	65.7	28.5	3.23	0.69
I believe I could do well in a career in manufacturing.	0.0	5.9	50.0	44.1	3.38	0.60

Overall, students liked learning about manufacturing jobs and felt they would do well in a career in manufacturing. Students were not as sure that they could see themselves working in these fields. In

responses to the open-ended questions, students stated that they learned about construction processes and how to obtain a career in related fields. They also suggested that future field trips provide opportunities for hands-on activities and more demonstrations. When asked if they liked the field trip, all the students responded that they did.

### **Other Activities**

Other PSCME articulation and interaction activities include:

- Museum of History and Industry curricular DVD, “The Changing Face of Northwest Manufacturing.”
- Case studies of entrepreneurs in manufacturing fields.
- Master Teachers would continue to develop partnerships with post-secondary educational institutions and industries.

As a means to sustain the work, MTAG and PSCME have recently hired a consultant to support and promote a “MTAG North” organization. In this role, the consultant would market MTAG services and modules to education and industry partners, and coordinate the MTAG Internship Project using MTAG modules.

## **CONCLUSION AND SUGGESTIONS**

To what extent has the program reached its objectives? With good intentions, PSCME staff has made some progress and worked to fulfill program objectives, although there is much more that can be done. For each area, suggestions are included that will support sustainability of program accomplishments.

### **Curriculum**

Curriculum has been developed that should help students meet national skill standards. The modules have undergone a number of pilot tests. Program staff gathered suggestions for improvement, and then provided revised modules to classrooms for implementation. With each pilot, the modules have been improved through the incorporation of teacher feedback.

The evaluation found that teachers are adapting module curriculum to meet their students' needs. This finding should be no surprise to curriculum developers. Producing teacher-proof curriculum would be unwise, and was opposed in the mid-90's by educational researchers (i.e., Darling-Hammond, Wise, Friedman, Kohn and others). Even though teachers were included in module curriculum development and review stages, when providing it to others, it is understandable that modifications would be made, thus it is difficult to get teachers to use the modules "as is" and to return student assessment data to the program.

With this in mind, the importance of the final assessments – a written knowledge test and hands-on team exercise – can not be emphasized enough. In order to show they can meet national skill standards, students must have ways to demonstrate their knowledge and skills. Extra effort is needed to make sure this happens. It is suggested that in the remaining months, PSCME staff work closely with MTAG leadership on the design of the final written knowledge test. The hands-on team exercise has been piloted, but needs external observers as part of the assessment team. This may be a burden on schools and should be revisited as a realistic strategy.

### **Professional Development for Educators**

There have been few professional development opportunities for teachers during the past year. Professional development should be clearly linked with student learning. Much is known about designing effective professional development for teachers (works from Sparks, Loucks-Horsley, Guskey and others). Clear goals that are communicated to teachers and a collegial learning environment are key elements of professional development opportunities.

The evaluation found that the level of teacher experience/development can affect module implementation. Novice teachers may find that the modules provide much needed curriculum support, but that classroom management skills/support are also needed. On the other hand, experienced teachers either felt the modules did not add to their current curriculum and instructional strategies, or that only some parts of the modules would integrate easily in their classrooms.

PSCME has a few months remaining in which to place additional, concentrated energy into teacher professional development activities. It is recommended that PSCME: 1) Tap into teachers' experience as

a source of knowledge. 2) Help teachers consider the context of their schools and the needs of their students as they integrate the modules. 3) Assist teachers in the collection and analysis of student learning data. 4) Provide opportunities for teachers to collaborate with colleagues.

### **Articulation and Interaction**

The benefits of articulation between secondary and postsecondary programs are obvious. Articulation agreements can reduce duplication of learning, offer desirable options for students, and increase the number of students continuing their education by providing a smooth transition from high school to college. Through articulation agreements, students may become more aware of their choices and take steps toward successful academic planning.

Interactions between schools and businesses are also crucial to facilitate student transitions between school and work. Despite recent economic downturns, the Puget Sound region is beginning to emerge from a national recession. Manufacturing is showing steady growth. Businesses will need knowledgeable, productive workers. Creating student internships may be an ideal way to prepare students for the workforce.

PSCME has supported several activities for this objective, but there is much more that can be done. In the next few months, PSCME staff should work with MTAG to put in place sustainability strategies and develop ways to promote school/industry partnerships. Many opportunities exist, and the program needs to capitalize on them. Additional meetings with MTAG leadership may be needed to make sure this is accomplished.

## Appendix



Put the number of your **first choice** for a college major in this box:

Put the number of your **second choice** for a college major in this box:

1	Agricultural Science (animal science, food science, plant science)	14	Health Professions and Related Sciences (medicine, dentistry, nursing, pharmacy, public health, physical therapy)
2	Architecture/Environmental Design	15	Law/Prelaw/Legal Studies
3	Biological/Life Sciences (biology, genetics, physiology)	16	Mathematics (applied math, general mathematics, statistics)
4	Business Management/Administrative Services (accounting, general business, finance, marketing)	17	Physical Sciences (astronomy, chemistry, earth science, geology, oceanography, physics)
5	Computer and Information Science (computer programming, information services)	18	Communications (communications general, journalism)
6	Conservation/Renewable Natural Resources (environmental science studies, forestry)	19	Criminal Justice/Protective Services
7	Education (teaching math/science/computers, administration, counselor, special education)	20	Languages, Linguistics, Literature (English language/literature, foreign language/literature)
8	Engineering (aerospace, civil engineering, electrical engineering, industrial engineering, mechanical engineering, other engineering)	21	Home Economics
9	Liberal Arts/General Studies	22	Library Science
10	Parks, Recreation, Leisure, and Fitness	23	Philosophy, Religion, and Theology
11	Psychology (clinical, counseling, experimental, social)	24	Public Affairs (public administration, public policy studies)
12	Social Work	25	Social Sciences and History (anthropology, archeology, geography, history, international relations, political science, government, sociology)
13	Visual and Performing Arts (dramatic arts, fine arts, music)	26	Manufacturing (materials science, composites, technology)

THE FOLLOWING SECTIONS PERTAIN TO THE CLASS YOU ARE TAKING.

SECTION 2	DISAGREE		AGREE	
	Strongly	A Little	A Little	Strongly
Please tell us how much you <b>agree</b> or <b>disagree</b> with the following statements by marking one number for each.				
8. I am concerned about being able to complete the class requirements.	1	2	3	4
9. I am worried that I will not understand the math involved in the class.	1	2	3	4
10. I am worried that I will not understand the science involved in the class.	1	2	3	4
11. I plan to study or work in manufacturing after completing high school.	1	2	3	4
12. I think that participation in this class will help me get a job.	1	2	3	4
13. I expect this class to be an "easy A."	1	2	3	4
14. I think this class will be more fun than traditional classes.	1	2	3	4

SECTION 3	
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How would you describe your ability level for each of the following?	Beginner	Intermediate	Advanced
Math Skills	1	2	3
Science Skills	1	2	3
Engineering Skills	1	2	3
Technology Skills	1	2	3
Manufacturing Skills	1	2	3
Problem Solving Skills	1	2	3
Skills in Hands-on Manufacturing Processes	1	2	3

<b>SECTION 4</b>	
Please circle the correct answer to the following:	
1. Manufacturing sectors such as biotechnology, transportation, pharmaceuticals, and electronics need workers.	True                      False
2. Basic skills manufacturing employees need are communication, teamwork, and a good work ethic.	True                      False
3. Basic elements of most manufacturing operations are:	A. Input, Process, Output, Feedback B. Input, Problem Solving, Goal Attainment C. Problem, Process, Goal Attainment

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**SECTION 5: Open-ended Responses**

3. What do you hope to learn by participating in the course?

4. What is your greatest concern about participating in the course?

5. Please include additional comments or concerns:

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College Renton Technical College (RTC) Grant # 145-111-1MG5-EZ  
 Faculty member Multiple  
 Vocational/technical program Multiple  
 Dollars expended final figures will be tallied once all faculty timesheets have been received and included in final invoice  
 Describe what these funds were used for food for event, faculty wages and benefits

Describe the project activities.

*Curriculum:*

*Instructors reviewed MTAG modules, and identified modules to use in their classes. The following modules were reviewed but deemed not sufficiently rigorous for college-level work:*

- *Statistical Process Control (Machine Technology/CNC)*
- *Shop Skills (Machine Technology/CNC)*
- *Safety in Manufacturing (Machine Technology/CNC)*

*The following modules were reviewed and used in manufacturing programs:*

- *Computer Applications (Machine Technology)*
- *Manufacturing Field Trip (Drafting)*
- *Applied Mathematics (Welding and Developmental Math)*

*These modules were deemed comprehensive, relevant to industry, and helpful in framing concepts to be covered later in program.*

*Additionally, RTC plans to develop a part-time Basic Manufacturing program that would make use of all MTAG modules. This program will likely start in April 2005. A meeting is scheduled for November 30 with Shoreline Community College's Center for Manufacturing Excellence staff, to learn how they structured their program and whether this structure would be appropriate for RTC as well.*

*Promotion of manufacturing industry:*

*In the spring, we hosted an event for 36 high school students and their teacher/counselor chaperones in the Seattle MESA (Math, Engineering, and Science Achievement) program and the South King County Tech Prep Consortium. The event was held while RTC classes were in session. This meant the costs were much less, because faculty did not have to be paid extra to attend. Students got to participate in the Machine Technology/CNC, Job Skills for Trade & Industry, and Computer Science programs directly. For others, where it was not feasible to have the high school students doing hands-on events while the college students were there, we made alternative arrangements. Some RTC counselors led students on a campus tour and did other types of activities (such as guessing what tool a program was from and what it would be used for, and an Internet search for financial aid resources for professional-technical training). This event was well-received by students, chaperones, and faculty alike. We are planning additional campus events for the 2004-2005 school year.*

Describe how this project benefited faculty, students, the technical programs, and the institution.

*This project gave faculty additional curriculum materials and techniques for their classes, which in turn benefited their students and the technical programs they teach.*

*The project also benefited prospective students, both those still in high school who may enroll in full-time programs and those adults who are interested in manufacturing and want part-time training.*

*We expect the new Basic Manufacturing program to help the college attract additional working adults by giving them a certificate program, not just individual classes, that they can take in the evenings. This is consistent with one of the Instruction division's goals of creating more flexible delivery formats.*

*The college also benefited from the PSCME grant – or, perhaps more accurately, by the PSCME in general -- by building closer ties with neighboring colleges. In part because of the work that RTC, Lake Washington Technical College, and Shoreline Community College did together over the course of the PSCME grant period, the three colleges are now pursuing other opportunities to work together. We are working on creating a regional student chapter of the Society for Manufacturing Engineers (SME) and we are writing a joint grant proposal from the SME Foundation. These types of projects ensure that the PSCME will have a lasting impact on manufacturing education in the region.*

**Puget Sound Consortium for Manufacturing Excellence (PSCME) and  
Manufacturing Technology Advisory Group (MTAG)**

**Student Field Trip Survey**

We would like to ask you questions about the field trip so we can understand the outcomes and can make future field trips better. Responses to the survey will be summarized by the Center for Research and Learning and returned to the field trip planners. Circle one response for each question, unless asked to circle all that apply.

1. What grade are you in?                    **9<sup>TH</sup>**    **10<sup>TH</sup>**    **11<sup>TH</sup>**    **12<sup>TH</sup>**

2. Please describe yourself: (Circle all that apply.)

- |                                 |                         |                                |
|---------------------------------|-------------------------|--------------------------------|
| <b>BLACK/AFRICAN AMERICAN</b>   | <b>PACIFIC ISLANDER</b> | <b>LATINA/O AMERICAN</b>       |
| <b>WHITE/CAUCASIAN AMERICAN</b> | <b>ASIAN AMERICAN</b>   | <b>NATIVE AMERICAN/ALASKAN</b> |
| <b>OTHER _____ (SPECIFY)</b>    |                         |                                |

3. Your gender:                                    **FEMALE**                    **MALE**

**Questions 4-12: Please tell us how much you agree or disagree by circling one number for each.**

	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly Agree</b>
4. I like to learn about manufacturing jobs.	1	2	3	4
5. I am interested in a career in a manufacturing field.	1	2	3	4
6. I know the required qualifications for a job in manufacturing.	1	2	3	4
7. I could work in any of the work environments we saw today.	1	2	3	4
8. I might want to be a manufacturing technologist one day.	1	2	3	4
9. I might want to be an engineer one day.	1	2	3	4
10. Today I learned about my responsibilities as an employee.	1	2	3	4
11. Today I learned about required skills for a variety of jobs.	1	2	3	4
12. I believe I could do well in a career in manufacturing.	1	2	3	4

13. Tell us about two things that you learned from the field trip.

14. Suggest two things to make the field trip better.

15. Overall, how much did you like the field trip?

- |                                 |                          |                    |                           |
|---------------------------------|--------------------------|--------------------|---------------------------|
| <b>I REALLY DIDN'T LIKE IT!</b> | <b>I DIDN'T LIKE IT.</b> | <b>I LIKED IT.</b> | <b>I REALLY LIKED IT!</b> |
|---------------------------------|--------------------------|--------------------|---------------------------|

16. If you could go on another field trip about manufacturing technology, would you want to?

- |                       |                     |                 |                       |
|-----------------------|---------------------|-----------------|-----------------------|
| <b>DEFINITELY NOT</b> | <b>PROBABLY NOT</b> | <b>PROBABLY</b> | <b>DEFINITELY YES</b> |
|-----------------------|---------------------|-----------------|-----------------------|