

Aligning Sheboygan Area School District's Metals/Manufacturing Machine Tool

Curriculum to Meet Local Needs

by

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ABSTRACT

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At the time of this study, the Sheboygan Area School District's Metals/Manufacturing Machine Tool curriculum was not serving the needs of the community. Research was needed to determine modifications to the current machine tool curriculum to create an alignment between the school district and the local area. An active advisory committee stressed the importance of updating the district's machine tool curriculum to meet local manufacturing and technical college standards. To accomplish this goal, the researcher used an interview and survey to determine what machine tools are used in the Sheboygan area, what machine tool careers are readily available in the

Sheboygan area, what machine tool proficiencies are expected of entry level machine tool employees and technical college students, and what modifications must be made to the current machine tool curriculum to align the curriculum with the needs of the Sheboygan area manufacturers and post-secondary machine tool programs.

After reviewing the data, the researcher concludes that the existing Metals/Manufacturing Machine Tool curriculum is adequate for teaching manual machine tool skills. However, the curriculum does not reflect current machining processes and skills used by local industries and technical colleges. Changes that are required include using computer controlled machine tools, incorporating metric measurement systems, increasing the use of modern cutting tools, and investigating the development of machine tool cells in the school district's machine tool facility layout.

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Chapter I: Introduction

Introduction

Over the past 30 years, new technologies have made a dramatic impact on manufacturing, making it possible to produce goods of better quality, faster, and at lower costs (Krar). Advances in manufacturing technology are helping drive favorable productivity and labor cost numbers as new machine tool technologies enter the manufacturing market (MMS, 2004). Computerized machining processes and other technologies have changed the way products are manufactured and the face of manufacturing.

Sheboygan Area School District is located in the city of Sheboygan, Wisconsin, on the East shores of Lake Michigan about one hour North of Milwaukee. The city of Sheboygan has approximately 50,753 residents. In 2004, *Morgan-Quitno Press* ranked the city of Sheboygan the seventh safest city in the nation.

The Sheboygan Area School District has two high schools educating approximately 1,600 students in each building. The school district has a comprehensive Technology Education Department employing 16 Technology Education instructors to teach the various courses associated with Technology Education. The Sheboygan Area School District has two Metals Manufacturing Programs with annual student enrollment of 120 students in each program.

According to The Department of Workforce Development February, 2004 manufacturing makes up 34% of the total number of jobs in Sheboygan County. This survey done by the Department of Workforce Development stated that three out of the five largest employers in Sheboygan County, those with more than one thousand

employees, were involved in manufacturing. Employer data shows manufacturing jobs in the county, even in a time of economic trouble, still have the most job availabilities and the highest annual wage earners by sector. With this much manufacturing in one particular area it is crucial that a strong machine tool curriculum be established in the largest school district in that community.

It is important that new manufacturing technologies be incorporated in the Sheboygan Area School District's Metals/Manufacturing Program as soon as possible. The standard machine tool curriculum which has been used for the last 30 years by many machine tool programs secondary and post secondary does not adequately prepare students for entering into many modern machine shops (Krar, p ix). "What students need today to enter local industry or post secondary education is knowledge of conventional machine theory and processes along with basic knowledge of manufacturing processes and technologies". (Krar,Rapiisarda, Check ix) After examination of the Sheboygan Area School District's machine tool curriculum, many of the processes and theories currently being taught are adequate. However, many of the classical processes considered to be important components of machinist training are no longer taught in technical colleges or even done in manufacturing (Kibbe, ix). With all the technological advancements, it is time to incorporate machine tool technologies that update the standards of the Sheboygan Area School District's Metals/manufacturing program to resemble machine tool standards and practices used throughout the world. The use of technology in "school shops" motivates students toward modern careers in manufacturing and increases student learning (MMS, 2003). Thousands of middle schools and high schools are using CAD/CAM/CNC modules to give students a chance to design a part,

create a tool path, and machine parts. While the intention is not to make machinists out of every student who goes through the class, there is an opportunity for everyone to experience the processes of design and manufacturing (MMS, 2003).

To best serve the students and community needs it is essential that research be done to align the Sheboygan Area School District's Metals/manufacturing machine tool curriculum to represent local manufacturing and technical college machine tool standards.

Statement of the Problem

Currently, the Sheboygan Area School District's Metals/manufacturing curriculum is focused on teaching machining skills that have become outdated. To prepare students for the future, it is essential that the district realign this curriculum to meet the needs of today's manufacturers. In order to update the curriculum, research is needed to find the relationship between the school district's current program and the actual needs of the local community. Aligning the curriculum with the requirements of manufacturing standards of today will assure students a smooth transition into post-secondary machine tool programs and careers in the local manufacturing community.

Purpose of the Study

As stated above, it is essential that the Sheboygan Area School District redesign its Metals/manufacturing curriculum so that students will be prepared for their futures, whether this is in industry or at the technical college. The results of this survey will be analyzed to determine the aspects of the curriculum that need to be changed.

Objectives

To align the Sheboygan Area School District's Metals/Manufacturing program to meet local needs the following objectives will be addressed. This research will determine:

1. What types of machine tools are used by Sheboygan area manufacturers.
2. What machine tool careers are most readily available in the Sheboygan area.
3. What machine tool proficiencies are expected of entry level employees and technical college students.
4. What modifications must be made to the Sheboygan Area School District's Metals/Manufacturing program to align the curriculum with the needs of the Sheboygan area manufactures and post-secondary machine tool programs.

Rationale of the study

The Sheboygan Area School District's Metals/Manufacturing machine tool curriculum needs to be revised to align with current machine tool practices used by the local post-secondary machine tool programs and the manufacturing community.

Aligning the Sheboygan Area School District's machine tool curriculum to meet the needs of the local community will give the students a better machine tool educational experience and the opportunity to have a smooth transition into post-secondary machine tool programs and careers in the local metalworking community.

Limitation of the study

Limitations of this study include:

1. The research only pertains to local machine tool facilities in Sheboygan area.
2. The research was based on replies from the interview and survey.
3. The research only consists of data collected in the spring of 2005.
4. The research survey was designed by the researcher.

Definition of Terms

AMTDA	American Machine Tool Distributors Association (Krar, Rapisarda, & Check, 1998)
CAD	(Computer Aided Design) The use of computers in various stages of design of a product or component. (Krar et al., 1998)
CAM	(Computer Aided Manufacturing) The use of computers to control machining and manufacturing. (Krar et al., 1998)
Carbide Tooling	Tooling that uses a carbide insert to machine. Carbide tooling increases cutting speeds 300 – 400%. (Krar et al., 1998)
CNC	(Computer Numeric Control) A system in which a program is used to precisely position tools and / or the work piece and to carry out the sequence of operations needed to produce a part. (Walker, 1998)
Conventional – Machine Tool	A machine tool that does not use CNC technologies.
Conventional - Machining Process	Using a manual machine tool to produce a product.
EDM	(Electrical Discharge Machining) A process that removes metal by controlled electric spark erosion. (Krar & Check, 1997)
End Mill	A milling cutter usually smaller than 1 in. (25 mm) in diameter, with straight or tapered shanks. The cutting portion is cylindrical in shape, so that it can cut both on the sides and the end. (Krar & Check, 1997)
G – Code	In CNC programming, a preparatory function program code that calls a particular mode of operation such as rapid traverse, linear interpolation, or circular interpolation. (Kibbe, Neele, Meyer, & White, 2002)

HSS	(High Speed Steel) A hard steel, made of carbon, manganese, silicon, chromium, tungsten, and vanadium, used for the manufacture of cutting tools. (Krar & Check, 1997)
Lathe	A machine tool used for turning cylindrical forms of work pieces. (Krar & Check, 1997)
Machine Tool	That class of machines which, taken as a group, can reproduce themselves. Examples: Lathe, mill, drill, surface grinder, cutting tools, etc. (Walker, 1998)
Machining Center	A machine tool, similar to a milling machine, that is CNC controlled to perform a wide variety of machining operations automatically under the control of the part program.(Walker, 1998)
Machinist	A person who is skilled in the use of machine tools and is capable of making complex machine setups. (Walker, 1998)
Manual Machines	Machine tooling that does not have CNC capabilities.
Module Learning	A structured learning experience pertaining to one particular unit of study.
NIMS	National Institute of Metalworking Skills (MMS, 2003)
Tool & Die Maker	An experienced general machinist often involved with high precision work making other tools, dies, jigs, and fixtures used to support regular machining and manufacturing. (Kibbe, Neely, Meyer, & White, 1995)
Vertical Milling Machine	One of the most versatile and useful machines in a school or manufacturing shop. The many types of cutters and attachments That are available for this machine allow machining operations Such as end and surface milling, radius and cam milling, drilling, Reaming, boring, cutting slots and keyways, etc. to be performed. (Krar et al., 1998)

Chapter II: Literature Review

Introduction

The literature review will cover the advantages and capabilities of numeric control machine tools as well as provide insight on the evolving role of the machinist. This chapter will also examine area technical college Machine Tool Programs and conclude by covering the current metals/manufacturing training program for the Sheboygan Area School District.

Advantages and Capabilities of Numeric Control Machine Tools

In order for a manufacturing facility to compete in this global economy there is a need to produce parts faster, more accurately, and cheaper than the competitor. Computer controlled machine tools have many advantages and capabilities to the manufacturing community.

Computer control of machine tool has numerous advantages and capabilities. One distinct advantage is very rapid and high-precision positioning of both work piece and cutting tools. Modern CNC machines can position cutting tools and work pieces at rapid traverse feed rates of several hundred inches per minute to an accuracy of .0001 in. Once programming is complete, and tooling is set up, the machine tool can operate at full capacity 24 hours a day, even in the dark, with only routine service and cutting tool maintenance. (Kibbe, Neeley, Meyer, White, 2002, p. 675- 676)

Another advantage to CNC machine tools is their capability to produce multiple runs and products. Once a CNC program is established the machine tool operator can access that program anytime to run as many pieces needed.

When CAD, CAM, and CNC technologies are blended, the greatest capability emerges. This is the ability of a modern CNC machine tool to produce parts that would be extremely difficult or impossible to make by manual methods. This capability permits the design engineer to explore design that previously could not be manufactured by any manual methods. With manufacturing capability no longer a constraint for the product designers, this amazing ability of the computer-controlled machine tool is ushering in a whole new variety of precision machined component parts and other products.(Kibbe, Neely, Meyer, White, 2002, p.676)

A majority of machine shops in the Sheboygan Area have incorporated a high level of CNC machining into their company's profile. CNC machine tools have become the industrial norm. CNC machine tools are used in so many processes:

For example, anti-lock brakes, transmissions, fuel injection systems, and air bags on cars and trucks; personal computer hard drives and video recording equipment; connectors of all types; medical diagnostic equipment; appliances, faucets, lawn mowers and power tools-all these items and more contain components made by this industry. If you look around, it's likely that there is something within reach that contains a precision machined product. (PMPA (On-line), 2001)

As CNC machining takes over machine shops, the role of the machinist is evolving to keep up with these manufacturing standards.

Evolving Role of Machinist

Machine tool technologies are always changing and improving. Machine tool employers strive to stay abreast on the latest technologies to improve their company and stay competitive. As machine tool technologies advance, the need for educating the

workforce becomes necessary. Training machine tool students on sophisticated numeric controlled machines is crucial for preparing our students for entering the workplace.

We cannot expect high technology work from low technology workers; training can make the difference between success or failure. The ever changing technology means that industrial workers and students in schools must be prepared for continual education (life-long learning) if they expect to survive in the technological world which we live. (Krar, Check, 1997, p. 18-19)

Over the years the machinist's roles have evolved and changed to meet the needs of the manufacturing community. With the advent of CNC machine tools, the level of training and skills required to be a machinist have changed. Walker (1998) has shown:

Whether planning an NC program or preparing to produce work on a conventional machine tool, a machinist must make many decisions and determinations on how to manufacture a part in the most economical way. The machinist must:

- Make a thorough study of the print
- Determine the machining that must be done.
- Ascertain tolerance requirements
- Plan the machining sequence
- Determine how the setup will be made.
- Select the machine tool, cutter(s), and other tools and equipment that will be needed.
- Calculate cutting speeds and feeds.
- Select a proper cutting fluid for the material being machined.

Local Area Technical College Machine Tool Program Information

After review of three area technical college machine tool programs, research showed that all programs were structured to teach manual machining processes first semester and CNC machine processes thereafter to the completion of the program. CNC turning and milling centers were standard machine tools used in each of these technical colleges.

One area technical college website even goes as far as saying employers will expect a graduate of this program to:

- Operate CNC Machine tools
- Set up machines and required tooling
- Read and interpret CNC machine programs
- Use a variety of inspection equipment

It is essential to align the district's curriculum to meet the needs of the local community and that of the area technical college machine tool programs to insure a smooth transition into post secondary education for any district metals/manufacturing student.

Sheboygan Area School District's Current Metals/Manufacturing Curriculum

The metals/manufacturing program is composed of three courses: Metals production 1 & 2, Advanced Metals Production 1 & 2, and Vocational Metals Production 1 & 2. Student interested in careers in the metalworking industry are encouraged to take all three courses of Metals Production.

Metals Production 1 & 2 is a one hour, year long course open to any student in grades 10, 11, and 12. Students who successful complete Metals 1 & 2 will receive one

semester credit. Metals Production 1 & 2 has no prerequisites course work. The course description is:

The Metals Production course will give students an opportunity to develop basic skill in various areas of the metal working industry. Required projects and exercises in different types of welding, sheet metal, types and uses of manual machine tool, foundry, and working with hand tools in the bench metal area will be used to make students aware of the many metal working process. Students will also be able to concentrate in a specific are through the production of a project of their own choice with instructor approval. (SASD, 2004, p.81)

Advanced Metals Production 1 & 2 is a one credit, one hour, year long course offered only to students who successfully completed Metals Production 1 & 2. The course description is:

This Advanced Metals Production course will provide students an opportunity to develop more advanced skills in the metal working areas, which were covered in the metal production course. Additional skills in welding advanced manual machine tools and other metal technologies will be developed through the use of exercises and projects. Students will also be able to concentrate in specific areas of interest through individual projects with instructor approval. (SASD, 2004, p. 81)

Vocational Metals Production 1 & 2 is a two credit, two hour, year long course offered only to students who successfully completed Advanced Metals Production 1 & 2. The course description is:

This two-hour course is designed for the student who is planning a career in the metal working field. Development of technical skills is stressed along with development in lathe and milling machine operation. CAD, CAM, CNC, GMAW, GTAW, and SMAW welding, sheet metal pattern drafting, and oxy-acetylene welding and cutting process will be strengthened. Students may specialize in areas of their choice with instructor permission. Student exercises and projects will vary depending which area the student wishes to specialize in. (SASD. 2004, p. 82)

Future Program Progress

With technology changing ever so rapidly in the manufacturing community it is critical for educators to stay current with new machine tool technologies and manufacturing process. Krar and Check (1997) state:

To best serve the industry and increase the productivity of the nations, educators must continually introduce new materials into their curriculum to prepare students to enter the technological world of today. Old “time-proven” methods and processes have been outmoded by new technology. The educational institutions that recognize this and take appropriate steps will produce graduates who are a credit to their school and make a valuable contribution to the country. (p. 19)

The researcher concludes with the finding from Krar and Check (1997) defining what machine tools programs need to represent to stay current with the metalworking industry:

Technology Courses that offer machine shop, which provides the background and groundwork for all manufacturing technologies, is the prerequisite for all students

planning to enter the exciting manufacturing world. Along with the knowledge of the basic machining process, a good understanding of computer numerical control (CNC) is essential. In the world today, with approximately 90 percent of the machine tools manufactured for CNC use, a good knowledge of this area is as important as being able to read and write. (p. 19)

This literature review was very helpful to the researcher in determining the present state of machine tool technologies used in the metals/manufacturing community and that of the local technical college programs. It is very important that the researcher open the line of communication with the local technical college machine tool instructors and manufacturing representatives to align the Sheboygan Area School District's Metals/Manufacturing program to local industrial needs.

By keeping technology current and exposing students to the skills they will actually use in their future careers, student employment possibilities will be greatly increased. According to the U.S. Department of Labor 2000-2001 Occupational Outlook Handbook on line:

Despite slower than average employment growth, job opportunities will be excellent for machinist, as employers continue to report difficulties in finding workers with the necessary skills and knowledge to fill machining and CNC programming openings. (UMSL (On-line), 2000-01)

Chapter III: Methodology

Introduction

In order to update and align the curriculum to meet local needs, research is needed to find the relationship between the school district's current program and the actual needs of the local community. This research will determine what types of machine tools are used by the Sheboygan area manufactures. What machine tool careers are most readily available in the Sheboygan area and what machine tool proficiencies are expected of entry level employees and technical college students. In addition, the research will determine what modifications must be made to the Sheboygan Area School District's Metals/Manufacturing program to align the curriculum with the needs of the Sheboygan area manufactures and post-secondary machine tool programs.

This chapter will include information about the methods and procedures used in this study under the headings of Research Design; Sample Selection; Instrumentation; and Research Schedule.

Research Design

A descriptive research design was used, based on an interview and a survey attachment. The interview and survey was designed for both the local machine shop supervisors and local technical college machine tool instructors. This permitted the researcher to interview and survey, all participants at their respective work places individually to gain the best overall understanding of each facilities size, capabilities, and work environment. This method also allowed the researcher to clarify specific interview and survey questions based on the objectives for this study as well as tour each facility,

and establish a partnership between the Metals/Manufacturing program and local manufacturers and technical colleges.

Sample Selection

The participants in the interview and survey of local machine shop supervisors were selected based on their individual involvement with the Sheboygan Area School District's Metals/Manufacturing advisory committee. Selective participants included a diverse sample selection of machine shop supervisors including both production manufacturing facilities and specialized tool and die facilities. Three machine shop facilities matched these criteria. Because of the small size of the population, a 100% sample size was selected.

The participants in the interview and survey of area technical college machine tool programs were selected based on articulation agreements with the school district and their involvement of recruiting students from the Sheboygan Area School District's Metals/Manufacturing program. Three area technical colleges were selected to participate. Each participant was from a different technical college. Lastly, each technical college selected offered either a Machine Tool Technical Diploma or Associates Degree in Machine Tool. Three area technical colleges met these criteria. Two responded back for the interview and survey.

Instrumentation

The interview of machine shop supervisors explored general manufacturing questions to give a better understanding of what skills and educational requirements are required in an entry level employee. Topics discussed during the machine shop supervisor interview included products manufactured by the company, machine tools

used in the facility, the minimal educational requirements for employment, entry level measurement skills and tooling requirements, expected metallurgy knowledge, required machine tool proficiencies, and other manufacturing skills desired in an entry level employee.

The interviews of area technical college machine tool instructors explored general manufacturing questions to give a better understanding of the required skills and knowledge base desired in students entering the machine tool programs at area technical colleges. Topics discussed during the machine tool instructor's interview included manufacturing programs available to students enrolled at each technical college; a description of machine tools used in each program; characteristic and educational backgrounds desired in students enrolling into the machine tool program; desired measurement skills, metallurgy knowledge, and machine tool proficiencies, as well as, other manufacturing skills student's entering the machine tool program should have.

The surveys of machine shop supervisors and technical college machine tool instructors clarified what type of machine tool proficiencies, tooling, and soft skills an entry level machine tool employee or student should be able to perform. The questions on the machine shop supervisor's and machine tool instructor's survey included ranking important machine tool proficiencies to determine which machine tool skills and processes should be enforced, introduced, and dropped from the curriculum, the ranking of machine tools utilization at their facility, and selection of soft skills desired in entry level employees and students.

To collect the data for the interview and survey, the researcher contacted the local area machine shop supervisors and machine tool instructors and asked if they would

participate in the research. If the individual agreed, a date and time was arranged to conduct the interview and survey. At the start of the interview the participant was given the human research subject consent form to ensure them that their participation in this research project was voluntary and confidential. During the interview and survey the researcher took notes and interacted with the participant on comments and questions the participant had. Each participant was informed that their name and place of employment would be kept anonymous and all notes and information gathered from this interview and survey would be destroyed at the completion of this research project.

The data from the interview was evaluated by reviewing the notes and finding common answers to each interview questions. The researcher determined the mean and standard deviation of the data to analyze the information from the surveys. The interview notes and survey questions were cross-examined to identify associations.

To justify the validity and reliability of the interview and survey questions the author's department chair and research advisor examined and critiqued both the interview questions and survey. After revising the interview and survey questions to both the department chair and research advisors recommendations, the questions were considered valid and reliable to generate desired responses necessary for the data collection used in this research paper. After final approval from the research advisor, the interview and survey questions were sent to the University of Wisconsin-Stout Graduate College for approval of the research topic and protection of human subjects.

The interviews and surveys allowed the researcher to collect necessary data to find associations and relationships between current manufacturing and technical college machine tooling, processes, and entry level employee/student standards. The interviews

and surveys enabled the researcher to evaluate and determined necessary changes to the Sheboygan Area School District's Metals/Manufacturing machine tool curriculum to align with local needs. This in turn will help to assure students in the Sheboygan Area School District a valuable and rewarding machine tool experience helping them to transition into the local area workforce or technical college.

Limitations of the study included the research pertains to the local machine tool facilities in the Sheboygan area; the research was based on replies from the interview and survey; not all technical colleges chose to participate; the research only consisted of data collected in the spring of 2005; lastly, all interview and survey questions were designed by the researcher.

Data Analysis

The researcher aligned each of the four objectives with the matching questions from the survey which were given out. Some of the questions required statistical analysis including mean and standard deviation. The statistical analysis helped the researcher to determine the answer to each of the objectives.

Research Schedule

The data for the interview and survey was collected between March 15, 2005 and April 18, 2005. From April 18, 2005, through April 22, 2005 the interview and surveys were analyzed by the researcher in accordance to the objectives. The surveys were calculated for mean and standard deviation on April 23, 2005. From April 23, 2005 to April 26, 2005 collected data, mean, and standard deviation was analyzed by the researcher in accordance to the objectives and analyzed to the interview question responses.

Chapter IV: Results

Introduction

A descriptive research design was used, based on an interview and a survey. The interview and survey was designed for both the local machine shop supervisors and local technical college machine tool instructors. This permitted the researcher to interview and survey, all participants at their respective work places individually to gain the best overall understanding of each facilities size, capabilities, and work environment. This method also allowed the researcher to clarify specific interview and survey questions based on the objectives for this study, as well as, tour each facility, and establish a partnership between the Metals/Manufacturing program and local manufacturers and technical colleges.

The researcher organized the interview and survey responses in accordance to the objectives. The notes and survey responses from the interviews were reviewed and placed into a table. Each machine shop supervisor and machine tool instructor's responses were organized into this format to evaluate and determine similarities and justification to aligning the machine tool curriculum to meet the needs of the local community.

Five out of the six interview and survey participants participated in the research. The surveys were evaluated and analyzed by the researcher in four areas. The results are explained in this chapter under the headings of; Types of Machine Tools Used in the Sheboygan Area, Readily Available Machine Tool Careers In The Sheboygan Area, Expected Entry Level Machine Tool Proficiencies, and Needed Modifications To Current Machine Tool Curriculum.

Types of Machine Tools Used in the Sheboygan Area

Table 1 illustrates the results of objective 1 types of machine tools used in the Sheboygan area. The participants were asked to list the various machine tools their facility uses. Manual machine tooling was present in four of the five facilities interviewed. However, every machine tool facility used CNC lathes and mills as their primary machine source and plan to never purchase another manual machine tool again.

Table 1

Types of Machine Tools Used in the Sheboygan Area

Machine Tool Instructor and Machine Shop Supervisor	Comments
A.	Our facility is equipped with a mix of manual lathes and mills as well a good percentage of CNC lathes and mills.
B.	Our program utilizes CNC lathes, CNC Mills, Wire EDM, Radial Drill Press, Horizontal and Vertical Saws, and Surface Grinders.
C.	Our facility uses CNC Lathes, CNC Mills, all forms of manual machines, and boring bars.
D.	The machine shop consists of Screw Machines, CNC Lathes, and machining centers.
E.	Our tool and die shop is equipped with CNC Lathes, CNC Mills, Wire EDM, Radial Drill Presses, Horizontal Band Saws and Surface Grinders.

Readily Available Machine Tool Careers in the Sheboygan Area

Table 2 illustrates the results for objective 2 types of readily available machine tool careers in the Sheboygan Area by summarizing comments made by the machine tool instructor and machine shop supervisor interview. As you can see from table 2, obtaining a machine tool career in the Sheboygan area takes time, knowledge, and connections.

Table 2

Readily Available Machine Tool Careers in the Sheboygan Area

Machine Tool Instructor and Machine Shop Supervisor	Comments
A.	We recommend Wisconsin Job Net for looking for machine tool openings.
B.	Our Graduates have over 300 job posting they can apply for from our job posting bulletin board. Some employers even come to our campus and say we will hire anyone from your program if they are willing to work for us.
C.	Machinist jobs at our facility are difficult to get. Most people hired as a machinist work for several years before they have enough seniority to bid for one of our jobs. Many experienced machinists will go back to school to renew their skills before attempting to bid on a machinist job. We hire one machinist every six months to a year. All candidates must pass the required machining test before being hired in the machine shop.
D.	At our facility all of our employees are hired through word of

mouth. We post jobs on our bulletin board by the time clock and people spread the word to friends and family. If we have to I suppose we could use a temp agency if we couldn't find anyone. We hire as needed.

- E. Currently, we are not hiring. When we do hire, we post a newspaper add in the local paper for a CNC Machinist or Tool and Die Maker. We hire as needed.

Expected Entry Level Machine Tool Proficiencies

Table 3 describes the results of objective 3, machine tool instructor question number 3, characteristics and educational background required of an entry level student. Both technical college machine tool instructors interviewed agreed that a strong desire to learn is the best overall characteristic a student can have to be successful in a machine tool career.

Table 3

Desired Characteristics and Educational Background - Instructor

Machine Tool Instructor	Comments
A.	For our program all we ask is that the students be willing to learn.
B.	We like it when individuals enter the program already having a general knowledge of measurement, layout, tooling, and machine processes. However, these skills are not required to enroll.

Table 4 illustrates the results for objective 3 machine shop supervisor question number 4 the minimal requirements to be hired by an employer in the Sheboygan area.

Though every employer looks at each individual candidate, the minimum qualifications expected for being hired in a machine tool career consisted of a high school diploma or GED and related work experience or post-secondary machine tool education.

Table 4

Desired Characteristics and Educational Background - Supervisor

Machine Shop Supervisor	Comments
C.	A high school diploma or GED is the minimal requirement to be hired.
D.	The minimal requirements to be hired by our facility are a GED and related work experience. However, we do prefer to hire candidates with a technical diploma or degree.
E.	We require at least a high school diploma for general labor positions. In the machine trade, we expect some continuing education to be considered a viable candidate. We hire the most qualified individual for the posted position.

Table 5 depicts the results of objective 3 by summarizing machine tool instructor question number 3 expected machine tool proficiencies. Table 5 describes what measurement skills area technical colleges' desire in students' entering their machine tool program. Overall, any experience with precision measurement tools is helpful but not necessary.

Table 5

Desired Entry Level Measurement Skills - Technical College

Machine Tool Instructor	Comments
A.	We teach our students how to measure using micrometers and dial calipers. No experience reading or using precise measurement tools is required.
B.	Any experience a student entering the program has using a scale, micrometer, or caliper is excellent. We use the 5R scale and micrometers the most when making precise measurements.

Table 6 displays results for objective 3 by summarizing the comments made by the machine shop supervisor interview question number 4. For the most part, each of the machine shop supervisors agreed fluent knowledge of the English and Metric measurement system was critical.

Table 6

Desired Entry Level Measurement Skills - Machine Shop Supervisor

Machine Shop Supervisor	Comments
C.	Entry level employees are required to own and operate a dial indicator and base, combination square, tape measure, a fractional scale, and a dial or digital caliper.
D.	Though no tools are needed by employees at our facility. Everyone is required to read dial indicators, dial calipers, fractional scale, and micrometers. Digital measurement tooling is now being purchased to replace older measurement equipment. Our goal is to someday

have our measurement equipment wired to our computer to record quality control information.

- E. Entry level employees must be able to convert Metric prints to English measurements. Everyone is required to have their own tape measure, fractional scale, dial caliper, micrometer set, and dial indicator set.

Table 7 displays the results for objective 3 by summarizing the comments made by machine tool instructor interview question number 5. Desired knowledge about metallurgy theory varies among the technical college machine tool instructors.

Table 7

Desired Entry Level Metallurgy Knowledge - Technical College

Machine Tool Instructor	Comments
A.	Students do not need to have any previous metallurgy knowledge. We teach the basic metallurgy skills to our students when they take the required metallurgy class.
B.	Any previous metallurgy knowledge is helpful. In our metallurgy classes we tour a steel plant and watch steel be manufactured. Our metallurgy class covers tensile and strength testing, hardness testing and values, properties of elasticity and plasticity of materials, theory of alloys, both AISI and ASTM steel classification systems, and basic heat treating principles.

Table 8 illustrates results for objective 3 by summarizing comments made by machine shop supervisor interview question number 6 expected entry level employee metallurgy knowledge. As you can see every employer has their own view of what metallurgy knowledge an entry level employee should have.

Table 8

Desired Entry Level Metallurgy Knowledge – Machine Shop Supervisor

Machine Shop Supervisor	Comments
C.	Entry level employees should have a general knowledge of tensile strength testing and values, definite hardness testing and what the values mean for machining, an understanding of elasticity and plasticity in materials, and some basic knowledge of alloy theories and heat treating.
D.	At our facility all entry level employees need to understand the AISI steel classification system. The AISI steel classification system is what our facility uses when selecting and machining metal as stated on each project print on the shop floor.
E.	We want our employees to be able to perform hardness testing and know the values of the test, understand theory of alloys, the AISI and ASTM steel classification system, and understand basic heat treating principles.

Table 9 displays the results of objective 3 by summarizing comments made by the machine tool instructor interview question number 6. Each machine tool instructor agreed the accessibility of CNC machine tooling will force technical colleges to stay up

to date with the most commonly used CNC machine tooling available. As machine tooling changes, it will be the responsibility of the technical colleges to change with the times to keep program graduates current with industrial norms.

Table 9

Required Machine Tool Proficiencies - Technical College

Machine Tool Instructor	Comments
A.	The ability to safely and competently operate manual lathe, manual vertical mill, drill press, horizontal and vertical band saw, and surface grinders are important skills. However, being able to safely and competently operate CNC machine tools, operate machining center, operate wire EDM, and CMM tooling are the most highly required skills.
B.	The ability to safely and competently operate manual lathe, manual vertical mill, drill press, and surface grinders are valuable skills. Being able to safely and competently operate CNC machine tooling, machining centers, EDM and CMM tooling are highly required skills.

Table 10 displays the result of objective 3 by summarizing comments made by the machine shop supervisor interview question number 7. Each machine shop had its own opinion of highly required skills.

Table 10

Required Machine Tool Proficiencies - Machine Shop Supervisor

Machine Shop Supervisor	Comments
C.	The ability to safely and competently operate a drill press, manual lathe, and vertical mills are highly required skills. By being able to operate these tools all other forms of CNC machining are capable. I can train anyone on CNC machining if they can operate these machines.
D.	At our facility being able to operate a drill press, manual lathe, surface grinder, or manual vertical mill is not a required skill. Highly required skills are the ability to safely and competently operate CNC machine tools, machining center, EDM and CMM machines are.
E.	The ability to safely and competently operate a drill press, manual lathe, vertical mills, and CNC machine tools are highly required skills. Having the ability to operate a machining center, EDM, or CMM are not required skills. However, being able to operate these tools is a distinct advantage.

Table 11 displays the results of objective 3 by summarizing comments made by the machine tool instructor interview question number 7. All machine tool instructors interviewed agreed any manufacturing skills a student may have when entering a machine tool program will be helpful but not necessary. The most important attribute a student

can have when entering a machine tool program is a strong desire to learn the trade. All other skills can be learned through instruction and working with the machine tooling in the program.

Table 11

Desired Manufacturing Skills - Technical College

Machine Tool Instructor	Comments
A.	None needed.
B.	Manufacturing skills are not necessary when entering the machine tool program. Soft skills like being on time, listening to instructions, completing lab work, and showing a strong drive for wanting to learn is essential for success.

Table 12 displays the result of objective 3 by summarizing comments made by the machine shop supervisor interview question number 8. Each machine shop supervisor had varying opinions about other manufacturing skills desired in entry level employees. For the most part each machine shop supervisor desired knowledge of precision measurement, sawing and drilling operations, ability to thread materials, and an overall understanding of CNC programming and operation.

Table 12

Desired Manufacturing Skills - Machine Shop Supervisor

Machine Shop Supervisor	Comments
C.	Other manufacturing skills entry level employees should have include the ability to use precision measuring equipment, perform part layout, operate sawing and drilling machine tools, set-up and

operate manual lathes and mills, cut threads using a tap and die set, sharpen machine tooling, and be able to program and operate CNC machine tools.

D. Other manufacturing skills we look for in an entry level employee are the ability to use precision measuring equipment, operate sawing and drilling machine tools, cut threads using a tap and die set, and have the ability to program and operate CNC machine tooling.

E. At our facility other manufacturing skills we look for in entry level employees consist of the ability to operate sawing and drilling machine tools, the ability to operate manual lathe and mills, ability to cut threads using a tap, and the ability to program and operate CNC machine tools.

Table 13 illustrates needed modifications to the current Sheboygan Area School District's Machine Tool Curriculum based on both machine tool instructor and machine shop supervisor response to the survey. Survey participants were asked to rate each machine tool process as: an important concept - students should show thorough understanding of the skill; introduction of concept - students should be introduced to the concept; or drop the concept from the curriculum.

According to the surveys when dealing with Lathe Turning, Threading, and Boring were important concepts that students should show thorough understanding of the skill. The least important concept was Form Turning on the Lathe. On the Vertical Mill,

Flat Surface Milling was very important concept; and on the Drill, Drilling, Counterboring, Countersinking, Reaming, Tapping, and Boring were all very important concepts.

Table 13

Needed Modifications to Current Machine Tool Curriculum

		Mean	Sample Size
3 = Important Concept 2 = Introduction of Concept 1 = Drop Concept			
Lathe	Turning	3	5
	Taper Turning	2.2	5
	Form Turning	1.6	5
	Knurling	2	5
	Threading	2.6	5
	Boring	2.8	5
Vertical Mill	Flat Surface	3	5
	Gear Cutting	1.6	5
	Angular Milling	1.8	5
	Circular Milling	2.2	5
Drill	Drilling	3	5
	Counterboring	3	5
	Countersinking	3	5
	Reaming	3	5
	Tapping	3	5
	Boring	2.6	5

Table 14 displays modifications to the current Sheboygan Area School District's Machine Tool Curriculum based on both machine tool instructor and machine shop supervisor response to the survey ranking their facilities use of the following machine tools as machine is used all the time; most of the time; occasionally; or hardly ever used. The machines rated the highest included the CNC lathe and CNC mill, manual lathes, vertical mills, and drill press were also used occasionally. The surface grinder was rated the lowest.

Table 14

Ranking of Machine Tool Usage in Local Area

	4 = All the time	3 = Most of the time	2= Occasionally	1= Hardly ever
	Mean		Sample Size	
CNC Lathe	3.6		5	
CNC Milling Machine	3.6		5	
Manual Lathe	2.8		5	
Manual Milling Machine	3		5	
Drill Press	2.6		5	
Surface Grind	2.2		5	

Table 15 displays the suggested modifications to the current Sheboygan Area School District's Machine Tool Curriculum based on both machine tool instructor and machine shop supervisor response to the survey selecting the five most specific entry level machine tool skills as highly desired entry level skills students or employees should possess. Each participant was instructed to select the five most important skills based on their facility and experience. Print reading was selected by all survey respondents. The

ability to learn was also rated very high. Speed and feed knowledge, measurement/quality control, setup/protocol and mechanical aptitude were also important.

Table 15

Top Five Machine Tool Skills

Important Skill Entry Level Skills	Number Selected	Sample Size
Speed and Feed knowledge	3	5
Tooling Knowledge	1	5
Trouble shooting ability	2	5
CNC program knowledge	1	5
Print reading	5	5
Machine maintenance/repair knowledge	0	5
Measurement/Quality control knowledge	3	5
Set-up procedure/protocol	3	5
Mechanical Aptitude	3	5
Ability to learn	4	5

Summary

After reviewing all of the data, the researcher concludes for the most part the existing curriculum is adequate for teaching basic manual machine tool skills to high school students. However, some changes do exist including improving the Sheboygan Area School District's Metals/Manufacturing program with CNC lathe and mill capabilities.

Chapter V: Discussion

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study is to revise the Sheboygan Area School District's machine tool curriculum to align with current machine tool practices used by the local technical college machine tool programs and the manufacturing community. To better prepare Sheboygan Area School District students for the transition into post-secondary machine tool programs and manufacturing careers in the local community, information on current machine tool equipment, practices, and capabilities will be used to revise the current Metals/Manufacturing curriculum.

In this chapter the results of the study are grouped together and include a restatement of the problem, methods and procedures, major findings, conclusions, and recommendations.

Restatement of the Problem

Currently, the Sheboygan Area School District's Metals/Manufacturing curriculum is focused on teaching machining skills that have become outdated. To prepare students for the future, it is essential that the district realign this curriculum to meet the needs of today's manufacturers. In order to update the curriculum, research is needed to find the relationship between the school district's current program and the actual needs of the local community. Aligning the curriculum with the requirements of manufacturing standards of today will assure students a smooth transition into post-secondary machine tool programs and careers in the local manufacturing community.

Methods and Procedure

A descriptive research design was used, based on an interview and a survey attachment. The interview and survey instrument was designed for both the local machine shop supervisors and local technical college machine tool instructors. This permitted the researcher to interview and survey all participants at their respective work places to gain the best overall understanding of each facility's size, capabilities, and work environment. This method also allowed the researcher to clarify specific interview and survey questions based on the objectives for this study as well as tour each facility, and establish a partnership between the Metals/Manufacturing program and local manufacturers and technical colleges.

Major Findings

After reviewing the data collected from both local machine shop supervisors and technical college machine tool instructors, the existing Metals/Manufacturing curriculum is acceptable for teaching basic manual machine tool skills. However, current manufacturing and post secondary machine tool programs do not emphasize these basic skills. In order to better align the Sheboygan Area School District's Metals/Manufacturing Machine Tool curriculum to meet local needs, modifications to both the facility and curriculum need to be made.

Needed facility and curriculum changes include adding CNC lathes and mills to the facility, and modifying the current machine tool curriculum to reinforce essential machine tool proficiencies. These essential machine tool proficiencies were determined through this research project and include speed and feed knowledge, print reading,

measurement and quality control knowledge, and set-up procedures/ protocol proficiencies.

Conclusions

After review of the data, the researcher concludes that the existing Metals/Manufacturing curriculum is adequate for teaching basic manual machine tool skills. However, some modifications and additions are required including improving the Sheboygan Area School District's Metals/Manufacturing program with CNC lathe and CNC mill capabilities. Conclusions will be presented by the four objectives of this research project.

Objective one asked what types of machine tools are used by Sheboygan area manufactures. The researcher concludes that this objective identified CNC machine tooling was used overwhelmingly by everyone surveyed. CNC lathes, CNC mills, and machining centers were used as the main tools of production at every facility. Currently, CNC machine tooling is not used by the Sheboygan Area School District's Metals/Manufacturing program. Manual lathe and mill machine tools equipped with digital readouts are the machine tools used in the program. While manual machine tools are used as the district's main source of education; the data from table 14 indicates that both area technical college machine tool programs and manufacturing facilities rate manual machine tooling as being used occasionally at their facilities. The researcher recommends incorporating CNC lathe and mill capabilities into the Metals/Manufacturing program immediately to assure a smoother transition of students into area technical machine tool programs and the workforce. By not including CNC machine tools in the Sheboygan Area School District's Metals/Manufacturing program,

students in the district have not been given a true representation of the metals/manufacturing industry in the local community.

Objective two determined what machine tool careers are most readily available in the Sheboygan area. The research determined that machine tool careers in the Sheboygan area are difficult to obtain. As positions open, the machine tool facility will hire candidates with CNC training or experience as determined from the data collected from the interviews of machine shop supervisors. When a job position is available, most facilities will hire under the job title of Machinist, CNC Machinist, or Tool and Die Maker. Desired qualifications include 2-3 years CNC machining experience or technical college degree.

According to the U.S. Department of Labor Bureau of Labor Statistics, (May 2005) job growth in the machinist trade should grow through the year 2012 in the United States. This continued job growth equates to approximately 10,430 machinist jobs. The need to educate students about careers in the machine tool trade is essential. The researcher recommends incorporating CNC machine tools into the current curriculum to align with current manufacturing practices, job postings, and post-secondary machine tool programs. Incorporating CNC machine tools into the program will give students a valuable CNC machine tool experience to help them make objective decisions about post-secondary education goals and career decisions.

Objective three asked what machine tool proficiencies are expected of entry level employees and technical college students. The researcher concluded that entry level employee machine tool proficiencies vary greatly from the actual abilities of entry level machine tool students. As indicated in table 9, "The ability to safely and competently

operate manual lathe, manual vertical mill, drill press, and surface grinders are valuable skills. Being able to safely and competently operate CNC machine tools are highly required skills” was overwhelmingly agreed upon by both the vocational instructors and machine shop supervisors. The researcher concludes that the Sheboygan Area School District’s Metals/Manufacturing program incorporate CNC machine tool proficiencies into its Metals/Manufacturing Machine Tool curriculum to give students in the program the most valuable machine tool experience before transitioning into the community.

Objective four asked what modifications must be made to the Sheboygan Area School District’s Metals/Manufacturing program to align the curriculum with the needs of the Sheboygan area manufactures and post-secondary machine tool programs. Both machine shop supervisors and machine tool instructors were in agreement pertaining to the perceived curriculum modifications. According to the data collected in the interview and survey instrument displayed in table 14, CNC lathe and mill machine tools should be the primary machine tools used in training students to prepare them for entrance into the machine tool industry. Recommendations that Sheboygan Area School District’s Metals/Manufacturing Machine Tool curriculum be restructured to combine the use of manual machine tools as a way to teach basic machine tool process to students before exposing students to basic CNC machine tool proficiencies is vital. Restructuring the Metals/Manufacturing Machine Tool curriculum to this criterion will create an alignment of machine tool programs between the school district and the area technical college machine tool programs. This alignment could then create the opportunity for the school district to have articulation agreements for dual credit. Articulation of credit would give the Sheboygan Area School District’s Metals/Manufacturing program increased validity,

as well as, assuring students a smooth transition into area technical machine tool programs and the local manufacturing community.

The curriculum will be modified over the summer of 2005 to reflect desired curriculum changes indicated through this research.

Recommendations

After reviewing the data, the researcher concludes for the most part the existing curriculum is adequate for teaching basic manual machine tool skills to high school students. However, through the interview process some changes were overwhelmingly recommended. Recommendations to improve the Sheboygan Area School District's Metals/Manufacturing program are: to add CNC lathe and CNC mill capabilities; modify class project drawings to incorporate metric dimensioning, metric conversions, and tolerance readings; require students to use carbide face cutters for face milling and increase the amount of carbide tooling used by students in the program. It is also recommended that the instructor introduce cell manufacturing by assigning students to manufacturing cells consisting of one saw, one manual lathe, one manual vertical mill, one welding unit, one drill press and when facilities are upgraded one CNC lathe or mill to produce the required manufactured product for evaluation.

The researcher feels that the above recommendations need to be incorporated into the current Metals/Manufacturing Machine Tool curriculum to improve the overall quality of the program by aligning the curriculum to meet local industrial and post secondary standards and needs.

Recommendations for Further Study

The researcher has recommendations for further study in this area. Machine tool curriculum makes up sixty percent of the Sheboygan Area School District's Metals/Manufacturing program. Further research would be beneficial to find ways to align the welding and sheet metal fabrication portion of Metals/Manufacturing program to meet local needs. Tremendous job opportunities and careers exist in the Sheboygan area for students who want to pursue welding and sheet metal fabrication careers. Aligning these two career paths with the revised machine tool curriculum would give students in the Sheboygan Area School District an excellent educational experience.

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Appendix A:

Machine Shop Supervisor Interview and Survey Questions

TO: Machine Shop Supervisor
FROM: John Juckem, Machine Tool Instructor Sheboygan North High School
RE: Interview aligning Machine Tool curriculum to industry standards
DATE: January 11, 2005

Dear Machine Shop Supervisor,

I am conducting an interview of local machine shop supervisors to align Sheboygan Area School District's Metals/Manufacturing machine tool curriculum to local industrial needs. The findings of this study will be used to evaluate and modify the district's Metals/Manufacturing program and to complete my Plan B Thesis at UW-Stout.

Enclosed you will find a copy of the interview questions I plan to discuss with you regarding your facilities machine tool capabilities and needs. I will be contacting you within the next two weeks to set up a time for an interview.

Please look over the interview questions. The interview should only take a few minutes of your time and will be an excellent opportunity for us to discuss any concerns you may have about the current and future plans of the district's Metals/Manufacturing program.

Your input will be greatly appreciated.

Thank you,

John Juckem
Sheboygan North High School Metals Teacher
803-7706

Interview questions for local machine shop supervisors.

1. What products does your facility manufacture?
2. What type of machine tools does your facility use?
3. What are the most common manufacturing job posting in your facility? How often do you look to hire a new employee for these positions?
4. Please check the minimal requirements to be hired by your facility.

High School Diploma ___ GED ___
 Technical College Diploma ___ Technical College Associate Degree ___
 Related Work Experience ___

5. Does your facility use the English or Metric system for measurement and what measurement tools are entry level employees expected to use?

English System ___ Metric System ___

Please list all measuring tools an entry level employee should have upon hiring.

Vernier caliper ___ Dial Caliper ___ Digital Caliper ___
 Dial indicator and base ___ Fractional scale ___ Decimal scale ___
 Combination square ___ Micrometer 0-3 inch set ___ or metric equivalent set ___
 Micrometer 0-6 inch set ___ or metric equivalent set ___ Tape measure ___
 Test indicator ___
 Other: _____

6. What metallurgy knowledge is expected of entry level employees?

Knowledge of tensile strength testing and values ___
 Knowledge of hardness testing and values ___
 Knowledge of the properties of elasticity and plasticity in materials ___
 Knowledge of the theory of alloys ___
 Knowledge of the AISI steel classification system ___
 Knowledge of the ASTM steel classification system ___
 Knowledge of the basic principles of heat treating ___
 Knowledge of steel and metal production ___
 Knowledge of purchasing steel/metal ___
 Knowledge of spark testing ___

7. Please rank the following machine tools proficiencies as:

1 Highly required skill OR 2 Not required skill

Ability to safely and competently operate manual machine tools:

Lathe ___ Vertical Mill ___ Horizontal Mill ___ Surface grinder ___

Drill Press ___ Other _____

Operate CNC machine tool ___

Operate Machining center ___

Operate EDM ___

Operate CMM ___

9. What other manufacturing skills do you look for in an entry level employee?

Ability to measure using micrometers, vernier calipers, dial calipers, and digital calipers ___

Ability to perform part layout ___

Ability to operate sawing and drilling machine tools ___

Ability to set-up an operate manual lathes and mills ___

Ability to cut threads using tap and die set ___

Ability to sharpen machine tooling ___

Ability to program and operate CNC machine tools ___

Aligning Sheboygan Area School District's Metals/Manufacturing
Machine Tool Curriculum to Meet Local Needs
(Machine Tool Industry Survey)

Directions: Rate your response to this survey based on your facilities perspective. There is no right or wrong response. Your survey will be kept confidential.

3=IMP=Important Concept- Student should show thorough understanding of skill.

2=INTRO=Introduction of Concept- Student should be introduced to concept.

1=DROP=Drop Concept- Concept should be dropped from curriculum/no longer used.

Please rate the following machine tool process:

		<u>Responses</u>		
		IMP	INTRO	DROP
		3	2	1
Lathe:	Turning.....	3	2	1
	Taper Turning.....	3	2	1
	Form Turning.....	3	2	1
	Knurling.....	3	2	1
	Threading.....	3	2	1
	Boring.....	3	2	1
Vertical Mill:	Flat Surface.....	3	2	1
	Gear Cutting.....	3	2	1
	Fly cutting.....	3	2	1
	Angular Milling.....	3	2	1
	Circular Milling.....	3	2	1
Drill:	Drilling.....	3	2	1
	Counterboring.....	3	2	1
	Countersink.....	3	2	1
	Reaming.....	3	2	1
	Tapping.....	3	2	1
	Boring.....	3	2	1

Rate what machine tools your facility utilizes the most.

4 = All the time

3 = Most of the time

2 = Occasionally

1 = Hardly ever

CNC Lathe.....4	3	2	1
CNC Milling Machine4	3	2	1
Manual Lathe.....4	3	2	1
Manual Milling Machine....4	3	2	1
Drill Press.....4	3	2	1
Surface Grinder.....4	3	2	1

Select the five most important skills an entry level machine tool employee should have.

- _____ Speed and Feed knowledge
- _____ Tooling Knowledge
- _____ Trouble shooting ability
- _____ CNC program knowledge
- _____ Print reading
- _____ Machine maintenance/repair knowledge
- _____ Measurement/Quality control knowledge
- _____ Set-up procedures/protocol
- _____ Mechanical Aptitude
- _____ Ability to learn

Thank you for your support and commitment to the Sheboygan Area School District's Metals/Manufacturing Program.

Appendix B:

Machine Tool Instructor Interview and Survey Questions

TO: Machine Tool Instructor
FROM: John Juckem, Machine Tool Instructor Sheboygan North High School
RE: Interview aligning Machine Tool curriculum to industry standards
DATE: January 11, 2005

Dear Machine Tool Instructor,

I am conducting an interview of local technical college Machine Tool programs to better align the Sheboygan Area School District's Metals/Manufacturing machine tool curriculum to local industrial needs. The findings of this study will be used to evaluate and modify the district's Metals/Manufacturing program and to complete my Plan B Thesis at UW-Stout.

Enclosed you will find a copy of the interview questions I plan to discuss with you regarding your facilities machine tool program. I will be contacting you within the next two weeks to set up a time for an interview.

Please look over the interview questions. The interview should only take a few minutes of your time and will be an excellent opportunity for us to discuss any concerns you may have about the current and future plans of the district's Metals/Manufacturing program.

Your input will be greatly appreciated.

Thank you,

John Juckem
Sheboygan North High School Metals Teacher
803-7706

Interview Questions Technical College

1. What manufacturing programs does your technical college provide?
2. What type of machine tools do students use in your program?
3. What characteristics and educational backgrounds do you want your students to have when entering the program?

Ability to measure using micrometers, vernier calipers, dial calipers, and digital calipers ___

Ability to perform part layout ___

Ability to operate sawing and drilling machine tools ___

Ability to set-up an operate manual lathes and mills ___

Ability to cut threads using tap and die set ___

Ability to sharpen machine tooling ___

Ability to program and operate CNC machine tools ___

4. What measurement skills do you want your students to have when entering the program?

Ability to read and work in the English System ___

Ability to read and work in the Metric System ___

Ability to read:

Vernier caliper ___ Dial Caliper ___ Digital Caliper ___

Outside caliper ___ Fractional scale ___ Decimal scale ___

Tape Measure ___ Micrometer ___

Other:

5. What metallurgy knowledge do you want your students to have when entering the program.

Knowledge of tensile strength testing and values ___

Knowledge of hardness testing and values ___

Knowledge of the properties of elasticity and plasticity in materials ___

Knowledge of the theory of alloys ___

Knowledge of the AISI steel classification system ___

Knowledge of the ASTM steel classification system ___

Knowledge of the basic principles of heat treating ___

Knowledge of steel and metal production ___

Knowledge of purchasing steel/metal ___

Knowledge of spark testing ___

6. Please rank the following machine tools proficiencies as:
1 Highly required skill OR 2 Not required skill
Ability to safely and competently operate manual machine tools:

- Lathe ___ Vertical Mill ___ Horizontal Mill ___ Surface grinder ___
- Drill Press ___ Other _____
- Operate CNC machine tool ___
- Operate Machining center ___
- Operate EDM ___
- Operate CMM ___

7. What other manufacturing skills do you want your students to have when entering the program?

Aligning Sheboygan Area School District's Metals/Manufacturing
Machine Tool Curriculum to Meet Local Needs
(Technical College Survey)

Directions: Rate your response to this survey based on your facilities perspective. There is no right or wrong response. Your survey will be kept confidential.

3=IMP=Important Concept- Student should show thorough understanding of skill.

2=INTRO=Introduction of Concept- Student should be introduced to concept.

1=DROP=Drop Concept- Concept should be dropped from curriculum/no longer used.

Please rate the following machine tool process:

		Responses		
		IMP	INTRO	DROP
		3	2	1
Lathe:	Turning.....	3	2	1
	Taper Turning.....	3	2	1
	Form Turning.....	3	2	1
	Knurling.....	3	2	1
	Threading.....	3	2	1
	Boring.....	3	2	1
Vertical Mill:	Flat Surface.....	3	2	1
	Gear Cutting.....	3	2	1
	Fly cutting.....	3	2	1
	Angular Milling.....	3	2	1
	Circular Milling.....	3	2	1
Drill:	Drilling.....	3	2	1
	Counterboring.....	3	2	1
	Countersink.....	3	2	1
	Reaming.....	3	2	1
	Tapping.....	3	2	1
	Boring.....	3	2	1

Rate what machine tools your facility utilizes the most.

4 = All the time

3 = Most of the time

2 = Occasionally

1 = Hardly ever

CNC Lathe.....4	3	2	1
CNC Milling Machine4	3	2	1
Manual Lathe.....4	3	2	1
Manual Milling Machine...4	3	2	1
Drill Press.....4	3	2	1
Surface Grinder.....4	3	2	1

Select the five most important skills an entry level machine tool student should have.

- _____ Speed and Feed knowledge
- _____ Tooling Knowledge
- _____ Trouble shooting ability
- _____ CNC program knowledge
- _____ Print reading
- _____ Machine maintenance/repair knowledge
- _____ Measurement/Quality control knowledge
- _____ Set-up procedures/protocol
- _____ Mechanical Aptitude
- _____ Ability to learn

Thank you for your support and commitment to the Sheboygan Area School District's Metals/Manufacturing Program.