Wisconsin Industrial Employers' Perceptions of the Need for Graduates of Specific Industrial Technology Programs in the Wisconsin Technical College Districts

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A Research Paper
Submitted in Partial Fulfillment of the
Requirements for the
Master of Science Degree
in

Career and Technical Education

Approved: 6 Semester Credits

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August 2005

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Title: *Wisconsin Industrial Employers' Perceptions of the Need for Graduates of Specific Industrial Technology Programs in the Wisconsin Technical College Districts*

Graduate Degree/ Major: MS Career and Technical Education

Research Adviser: **Howard Lee, Ph.D.**

Month/Year: **August, 2005**

Number of Pages: **254**

Style Manual Used: **American Psychological Association, 5th edition**

ABSTRACT

The purpose of this study was to determine the extent to which industrial employers in each of the 16 Wisconsin Technical College System districts need graduates of electronics, mechanical design, machine tool, and welding related programs through the year 2010 in Wisconsin. Due to declining enrollments in the Wisconsin Technical College System's Industrial Technology department programs and budget constraints, college administrators have been forced to decrease staff and discontinue programs. Surveys were sent to 1,617 Wisconsin manufacturing companies in the spring of 2005 to determine their need for graduates of the four program areas cited. Responses were received from 391 companies of all sizes.

Seventy-eight percent of respondents planned to hire new employees in 2005 due to company growth and 52.5% planned to hire due to attrition. Companies reported

difficulty finding workers to fill open positions. The career area in which employers had the most difficulty finding workers was Machine Tool (61.8%). More than half of respondents had difficulty finding workers for Electronics (55.8%) and Welding (57.3%) related jobs and more than one-third (41.7%) could not find qualified workers for Mechanical Design positions. This study supported the results of previous studies conducted of manufacturing companies that predicted shortages of workers with the skills learned in these programs. If current trends continue, the number of Wisconsin Technical College System graduates of the industrial technology programs studied will not be sufficient to meet the needs of manufacturer's in Wisconsin through the year 2010.

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Acknowledgments

My first thank you is to Dr. Howard Lee, my primary advisor, for all the help, advice, encouragement, and support you gave me through the months of work on this project. Thank you for believing in me and never discouraging me in any way.

Thank you to my other committee members, Dr. Joseph Benkowski, Dr. Scott Springer, Dr. Jerrilyn Brewer, and Ms. Wendy Dittmann for your contributions of time, support and advice.

I would like to extend a very special thank you to Dr. Jerrilyn Brewer from Western Wisconsin Technical College for your continuous support, encouragement, advice and contributions of time and finances. It was through your help and encouragement that this project became a reality from its conception when we met to discuss the idea in the fall of 2003.

Thank you to the staff and work study students at Western Wisconsin Technical College who helped me with the mailing: Pat Mielke, Jessica Bingham, and those whose names I neglected to write down.

I would also like to thank all the research people of all 16 Wisconsin Technical College districts who found archived graduate follow up reports and sent them to me in the summer of 2004.

My family deserves special consideration in my acknowledgments for the time that this project took from them and the devotion and support that they continued to show

in spite of my focused neglect. To my daughter Kara: Thank you for helping me in many small and large ways and even shopping when I was too busy to leave the house...even though it meant you had to leave your house and drive to deliver! To my son Morgan: your encouragement, support, and faith in me meant a lot. Thank you also for leaving your new laptop for me to use when you moved to Florida so I could continue working when my computer was no longer reliable! I love you both more than you will ever know.

My last thank you and the dedication of my thesis go to my new husband, Glenn. Thank you for your patience and faith in me while I worked for a year and a half on this project and my other MS degree coursework. Thank you for not giving up on me when we were dating and we could not see each other very much. Thank you for putting up with my moodiness and intense focus and for your belief in my abilities.

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CHAPTER ONE

Introduction

Background

The manufacturing sector in the United States has experienced significant declines in employment in recent years. Since manufacturing employment peaked in 1998, more than three million jobs have been lost (Goozner, 2004). There are many reasons for the decline in employment. Many companies are moving production and lower-skilled jobs to other countries; however, although manufacturing has lost jobs, productivity has risen. Manufacturers are using newer technologies, more automation, and lean principles, so fewer people are needed to operate equipment, and those employees who remain require higher skills and more education (Goozner, 2004).

Wisconsin has been particularly hard hit by the decline in manufacturing jobs because manufacturing accounts for a larger percentage of its employment than it does in most other states. In the year 2000, manufacturing accounted for approximately 24% of Wisconsin's employment compared to the national average of 14% (Doyle, 2003a). According to the National Association of Manufacturers (2003a), Wisconsin lost over 85,000 of its manufacturing jobs between July 2000 and October 2003. Manufacturing jobs now account for about 20% of Wisconsin's jobs. While predictions are that few of these jobs will come back, industries may still be faced with a shortage of workers in the future due to retirements and the need for workers with the technical skills required to monitor and operate technologically advanced manufacturing systems. In *Grow Wisconsin*, Governor Doyle predicts that in 10 to 15 years, "Wisconsin will be faced with a significant labor shortage" (2003a, p. 15). If Wisconsin and the United States are to

remain competitive, the manufacturing sector must remain strong. In Governor Doyle's State of the State Address in January 2004, he expressed concern about the manufacturing industry and stated, "One area we have to get back on track is our manufacturing industry" (Doyle, 2004, ¶ 105). The United States Department of Commerce conducted roundtable discussions on the future of manufacturing in America and in its report one of the major concerns expressed by manufacturers was that the United States would not be able to compete globally without a more highly skilled workforce (2004).

Wisconsin faces other challenges besides the loss of manufacturing jobs. As of February 2003, the state faced a 3.2 billion dollar budget deficit for the biennium and Governor Doyle stated in his Budget Address (2003b) that the state was in a budget crisis. Funding to universities and colleges was reduced and Wisconsin's Technical College System districts were adversely affected. The Wisconsin Technical College System (WTCS) funding was decreased for the 2003-2005 biennium. There was no increase in general aid, and grant funding was reduced by more than $5,000,000 (Wisconsin Technical College System, 2003a). The sixteen districts that comprise the WTCS have had to deal with budget constraints due to the reduction of state aids and funding. In Western Wisconsin Technical College's 2003-2004 budget address, President Dr. Lee Rasch presented the budget to citizens and stated that the budget, "recognizes the severe reductions by Federal and State governments and limits on operating revenue to the Technical College System" (2003, p. 1). This district experienced a state aid decrease of 5.5% since the 1992-1993 budget and operates at the maximum tax rate of 1.5 mills.

Although Western Wisconsin Technical College has a severe budget crisis, the college is committed to meeting the needs of stakeholders.

While Wisconsin's technical colleges are faced with cuts in funding, there is a high demand for increasing programs to address the nursing and health care worker shortage. There has been an 80% increase of Nursing Assistant graduates and a 54% increase of Practical nursing graduates from fiscal year 1996-1997 to fiscal year 2001-2002 in the Wisconsin Technical College System (Wisconsin Technical College System, 2003b). In the same period of time, industrial technology programs common to most districts have seen significant declines in graduates. Welding has declined 18%, Machine Tool Technics has declined 22%, Machine Tool Operation has declined 47%, Mechanical Design declined by 25.9%, and Electronics declined by 54% (Wisconsin Technical College System, 2003b). The decline in industrial technology program enrollment at Wisconsin's post-secondary technical colleges has paralleled a decline in manufacturing. As a result of declining enrollments and the budget crisis, administrators have been faced with decisions to discontinue, reduce the size of the faculty, suspend programs, or modify curriculum. All of the aforementioned industrial technology programs, categorized as either diploma or associate degree, were in the top 25 programs by graduate numbers in fiscal year 2001-2002. Even as these industrial technology programs are being cut, projections from the State of Wisconsin, The Occupational Outlook Handbook, and National Association of Manufacturers (NAM) indicates that the decline in some of these programs may not be warranted.

The Occupational Outlook Handbook (U.S Department of Labor, Bureau of Labor Statistics, 2002-2003) indicated that job prospects for graduates of some industrial

technology programs experiencing declines are excellent. Welders, machinists, tool & die makers, and CNC programmers and operators are predicted to have many opportunities for jobs in those fields. While there are decreases or an insignificant increase in actual job numbers, there are fewer people available to fill positions opened by retirements.

According to the Wisconsin Job Outlook Leading Occupations projections for 2000-2010, and updated in November 2003, welding occupations are ranked third for careers requiring vocational training with an estimated 580 openings annually. Leading occupations requiring long-term on-the-job training of one year or more lists CNC machine tool operators as fifth and machinists as seventh with projected annual openings of 420 and 320 respectively (State of Wisconsin, Department of Workforce Development, 2003). Machinists, CNC operators, and tool & die makers generally start their careers by completing one- and two-year technical diploma programs at vocational colleges and receive advanced training when they are employed. For jobs requiring an associate degree, electrical/electronic engineering technicians were ranked ninth with an estimate of 80 openings per year. While mechanical design and electronics-related careers are not among the careers that have significant job openings, these programs are associate degree programs in which graduates could transfer credits to four-year colleges such as the Milwaukee School of Engineering.

Manufacturing industries have many challenges in the future, and one of them will be the need to have a highly skilled workforce. One of the major problems facing manufacturers today is a shortage of skilled workers and projections for the future indicate that the shortage will get worse. Wisconsin Technical College System graduate reports for welding, machine tool trades, and electronics occupations indicate that there

are fewer graduates of these programs than there are job openings when compared to job opening projections in the state. This indicates a potential shortage in the future. The Wisconsin Technical College System recently completed a survey and 12 roundtable discussions of businesses around the state. Besides the number one challenge of increasing health care costs, almost 60% of participants cited the loss of high skill jobs as a concern, 42% cited the number of workers facing retirement as a problem, 47% were concerned with the loss of Wisconsin's competitiveness as compared to other states and countries, and 41% were concerned with the shortage of skilled workers (Wisconsin Technical College System, 2004b). The roundtables and surveys were of a cross section of approximately 300 Wisconsin businesses, not specifically manufacturers. The National Association of Manufacturers periodically surveys manufacturers regarding skills and training issues. In their report, *The skills gap 2001: Manufacturers confront persistent skills shortages in an uncertain economy* (2001), getting qualified job applicants was cited as a problem for more than 80% of manufacturers, even though the country was in a recession. One of the job areas with a higher reported shortage was machinists, with about 75% of respondents experiencing moderate to serious shortages. When surveyed about where their employees receive training, the majority of manufacturers train in-house; with vocational and technical colleges identified as the second largest source of training.

The National Association of Manufacturers conducted another major research project, *Keeping America competitive: How a talent shortage threatens U.S. manufacturing* (2003b), that sought to find the reason for the decline of qualified manufacturing employees. The decline of manufacturing itself was not the reason, but the

media reports lead educators, high school counselors, parents, and students to believe that manufacturing jobs are becoming obsolete. Additionally, student perceptions of manufacturing are very negative with students making comments about manufacturing careers such as, "serving a life sentence," and being a "slave to the line" (2003b, p. 9). When this researcher questioned welding students about the reaction of high school counselors to their choice of career, two reported that they were told to go to four-year colleges and that they should not go into welding. These students' counselors told them that they should have a four-year degree that they could "fall back on." Today's high school students have little knowledge about what manufacturing careers are available, the skills required, the complexity and variety, the opportunities for personal advancement, or the high pay and benefits these careers provide.

Wisconsin's industrial technology departments in the technical colleges have been a major supplier of high-skilled employees for manufacturers. The negative perceptions of high school students about manufacturing careers have contributed to the decline in enrollments in industrial technology programs. These programs have been increasingly hard to fill and/or maintain the minimum numbers of students to run course sections. Technical college administrators, counselors, and instructors have to make decisions about the future of these programs and whether they should increase marketing efforts or discontinue the programs. As colleges are forced to discontinue programs that provide skilled workers for manufacturers, the labor crisis facing manufacturers could become reality. Because manufacturing is approximately 20% of the United State's gross domestic product (GDP), a shortage of skilled employees could lead to a further decline

in manufacturing as companies are forced to move production to other countries (National Association of Manufacturers, 2003b).

There is some evidence that demand is exceeding the availability of eligible job candidates. In the Western Wisconsin Technical College district, the demand for machine tool graduates has been higher than the graduates available. Several companies in the WWTC district, including C&C Machine and Venture Tool and Die, have contacted the researcher looking for graduates or recently advertised in the La Crosse Tribune; but students who were due to graduate were already employed or planned to work at other companies upon graduation. However, other area companies, such as Trane Company, have been downsizing their workforce. Western Wisconsin Technical College, Wisconsin Indianhead Technical College, and Chippewa Valley Technical College are three colleges in western Wisconsin that have decreased the faculty in the machine tool programs because of low enrollment and budget constraints. Wisconsin Indianhead Technical College has discontinued their electronics program and Western Wisconsin Technical College has discontinued the welding program at the Mauston campus.

There is a contradiction and confusion regarding the availability of jobs for graduates of industrial technology programs in Wisconsin's technical colleges. Media reports of the decline in manufacturing, optimistic and pessimistic reports of job openings and losses, declining enrollments in manufacturing-related careers in the technical colleges, and the resulting loss of programs in the technical colleges have created the dilemma facing industrial technology departments. Marketing programs targeting high school students, counselors, and parents to try to change their perceptions would appear to be the first step aimed at increasing enrollments; however, there is a need to know if

manufacturing employers, specifically those who would potentially hire graduates of the welding, machine tool, electronics, and mechanical design programs, will have job openings in the future.

Statement of the Problem

Due to declining enrollments in the Wisconsin Technical College System's Industrial Technology department programs and budget constraints, college administrators have been forced to decrease staff and discontinue programs. Wisconsin's Department of Workforce Development job projections indicate that there will be many openings for graduates of some of these programs and studies conducted of manufacturing companies predict shortages of workers with the skills learned in these programs. Because of the significant decline in manufacturing jobs in the past three years, there is a need to know if employers who would potentially hire program graduates have the same perception of the need for new employees in the future as the projections indicate. It would not be ethical to market programs for which graduates would not be able to find employment. It is unknown to what extent industry employers have a need for graduates of the welding, machine tool, electronics, and mechanical design industrial technology programs in the Wisconsin Technical College Districts.

Purpose of the Study

The purpose of this study is to determine the extent to which industrial employers in each of the 16 WTCS districts need graduates of welding, mechanical design, machine tool, and electronics programs through the year 2010 in Wisconsin. Surveys will be sent

to industrial companies in February of 2005. The results of the study could be used by administrators in the WTCS districts to help them understand the future need of industries for short-term and long-term planning. The information from this study can also be used by each of the 16 WTCS districts to help them determine which of these industrial technology programs should have an increased focus on marketing to meet the needs of industries. Secondary and post-secondary education counselors can use the results of this study to inform them of career opportunities in the welding, electronics, machine tool, and/or mechanical design fields so they can help guide students in career choices.

Research Questions

This research will answer the questions:

1. To what extent does Wisconsin's industry employers' perceptions of employment needs warrant the decline in specific Industrial Technology Department programs in Wisconsin's technical college districts?
2. To what extent do industry perceptions of employment needs coincide with Department of Workforce projections?
3. Which industrial technology programs have more viability than others based on the projected need for graduates?
4. In which technical college districts is there a greater need for specific Industrial Technology programs?
5. To what extent do employers have difficulty finding qualified workers to fill open positions in selected areas?

6. What are industrial employers' short-term needs for graduates of Industrial Technology programs?

7. What is the perception of the need for graduates of these programs through the year 2010?

Significance of the Study

This study is important to Wisconsin's industrial employers, technical college administrators, and industrial technology instructors for the following reasons:

1. The decline in enrollments in Industrial Technologies programs could have a deleterious effect on Wisconsin's economy if efforts are not made to increase enrollments. If programs are discontinued even though industry need for graduates is high, the industries will have to find alternative ways to train employees or move their companies to other states or countries; however, if manufacturers do not have jobs for graduates of these programs, it would be unethical for technical colleges to promote the programs. There is a need to know if these programs will be needed in the future to provide manufacturers with workers.

2. Instructors and administrators are faced with the dilemma of not knowing whether the Industrial Technology programs of welding, machine tool, mechanical design, and electronics are viable and whether marketing campaigns should be increased because every day the news laments the decline of manufacturing. To understand the market for graduates and to facilitate planning, Wisconsin technical college administrators have a need to know what industry

perceptions are regarding the need for graduates of these programs and how the need varies between programs and within the districts of the state.

3. This study seeks to determine the extent to which welding, machine tool, mechanical design, and electronics programs are needed based on the perceptions of industries that would hire graduates of these programs. Based on the outcome, administrators could make more informed decisions as to the future of these programs. While State and Occupational Handbook projections are available, there is a need to know if those projections reflect the current perceptions of employers. Based on the correlation of projections and perceptions, educators can decide whether to increase marketing and recruitment of certain programs, eliminate programs, or to offer some programs only in certain districts.

4. This study can help WTCS district administrators decide where further studies need to be conducted for future needs and modifications of the welding, machine tool, mechanical design, and electronics programs.

Assumptions of the Study

The following assumptions have been made regarding the study:

1. Employers who return the survey completed will have had a knowledgeable person complete the survey. Some persons would have more insight than others regarding the future of a company. Presidents or vice-presidents would generally be more informed than a shop manager regarding the future vision of a company.

2. The researcher assumes that respondents will answer survey questions honestly, regardless of what their opinions are of technical college program curricula or former graduates.

Limitations of the Study

The following items have been identified as potential limitations of the study:

1. The survey was prepared by the researcher. While program committee members, administrators, and selected staff members reviewed the instrument, the actual validity and reliability of the instrument may still be questionable.

2. The sixteen technical college districts being surveyed vary in size and are a mix of urban and rural communities. There may be too few respondents of certain program employers for a statistically significant sample.

3. The study takes place in early 2005 and the data is restricted to this time period. It may not reflect events that could occur that would influence responses if a future study or longitudinal study were conducted.

4. This study is being conducted of industries that are typically busy and they may not be likely to respond to surveys that they may view as insignificant or time consuming. The researcher has no control over who responds and who does not.

5. Presidential elections took place in November of 2004 and may influence the optimism or pessimism of the respondents.

6. Survey respondents may have favorable or unfavorable bias toward technical colleges and responses may be influenced by ideals rather than realities. Some

employers may want to see colleges retain programs, even though they may not have immediate needs for graduates.

Definition of Terms

The following terms are defined for clarity of understanding regarding this study:

Computer Numerical Control (CNC): machinery and equipment movements that are controlled by a computer system that has had coordinate movements entered as numbers into a program.

Electronics programs: associate degree and diploma courses of study that prepare students for careers in electronics fields such as electromechanical technology, electrical engineering technology, electronic servicing technology, biomedical electronics, and other related careers.

General aid: "state aid which is not limited to any specific program, purpose, or target population but which may be used in financing the general educational program as seen fit by the recipient district" (Wisconsin Department of Public Instruction, 2004, ¶ 1).

Gross Domestic Product (GDP): "the gross national product excluding the value of net income earned abroad" (Merriam-Webster's online dictionary, 2004, n.p.).

Industrial Technology Programs: programs that prepare students for careers in industries that combine technology with the manual creation of products, goods, or services. They include automotive technology; graphic design; printing and publishing; air-conditioning, heating and refrigeration technology; wood technics; mechanical design; and many other programs.

In-house: "existing, originating, or carried on within a group or organization or its facilities: not outside" (Merriam-Webster's online dictionary, 2004, n.p.).

Lean Principles: putting processes in place that use a systematic approach to reduce waste in manufacturing and increase productivity.

Machine tool program: technical diploma courses of study that prepare students for entry level careers as machinists, tool & die makers, toolmakers, moldmakers, CNC operators, and CNC programmers.

Mechanical Design program: associate degree course of study that prepares students for careers where they will design prints of products using computer aided drafting software and select materials and processes to manufacture those products.

Tax mill rate: one mill is equal to $1.00 of tax for each $1,000 of property assessment.

Technologies: a manner of accomplishing a task especially using technical processes, methods, or knowledge (Merriam-Webster's online dictionary, 2004, n.p.).

Welding programs: technical diploma programs that prepare students for careers as welders, fabrication welders, and related careers.

Wisconsin Technical College System: Wisconsin's career, vocational, and technical college system that is comprised of 16 districts. They offer a comprehensive choice of programs to prepare persons for careers and course offerings for personal enrichment and career advancement opportunities.

CHAPTER TWO

Literature Review

Introduction

The purpose of this study was to determine the extent to which industrial employers in each of the 16 Wisconsin Technical College System districts needed graduates of the electronics, mechanical design, machine tool, and welding programs through the year 2010 in Wisconsin.

This chapter will discuss the importance of manufacturing to the United States economy, the decline in manufacturing jobs in the United States and Wisconsin, the economic crisis in Wisconsin as it relates to the Wisconsin Technical College System (WTCS), the importance of the Wisconsin technical colleges to manufacturers, and the impact of the manufacturing decline and the economic crisis on industrial technology programs in the technical college districts. In addition, a focus on four specific programs that are common to most districts in the industrial technology departments of the technical college districts will be examined, along with employment projections and the impacts of a predicted worker shortage on Wisconsin's economy. A review of surveys of businesses and industries conducted by Master of Science graduate students and a summary conclude the chapter.

Importance of Manufacturing to the United States Economy

Manufacturing in the United States has been described as "the heart of our economic strength and national security" (Jasinowski, 2003, ¶ 19), "the engine of our economic growth" (Joel Popkin and Company, 2003, p. 1), and "the backbone of our

economy and the muscle behind our national security" (U.S. Department of Commerce, 2004, p. 1). The United States is currently the largest producer (U.S. Department of Commerce, 2004) and exporter of manufactured goods in the world (Joel Popkin and Company, 2003), and because of this strong manufacturing base, it is also an economic leader in the world (Forbes, 2004).

There are many reasons why a strong manufacturing base equates to a strong economy. The high multiplier effect of manufacturing on other sectors of the economy; productivity gains as a result of innovation from research and development; high wages and benefits that create a higher standard of living for manufacturing employees and their families; the manufacturing process infrastructure effects on transportation, communications, and electronic commerce; a greater selection of goods for consumers that are of higher quality; and the larger community tax base are some of the reasons manufacturing is important to the U.S. economy. This section will explain each of these factors in more detail.

In the 1990's, the two sectors that contributed the most growth to the U.S. economy were manufacturing and the combined businesses of finance, real estate, and insurance. Each of these sectors was responsible for 22% of the economic growth, with the services and retail sectors each contributing 14% to the growth of the economy (National Association of Manufacturers, 2003e). When comparing economic growth in the U.S. and other countries, there tends to be a positive correlation between growth in industrial production and growth in other sectors of the economy (National Association of Manufacturers, 2003e). Growth of less than 1.5% annually could be harmful to the nation's economy, and countries that don't have growth in the manufacturing sector tend

to have economic growth of less than 1.5% overall (Joel Popkin and Company, 2003). The U.S. experienced an average growth of the economy of 3.2% per year during the 1990's (Joel Popkin and Company, 2003), with manufacturing averaging 4% during the latter half of the decade (Forbes, 2004).

To justify manufacturing and industrial production as the reason for growth in other sectors of the economy, an examination of the multiplier calculations from the United States Commerce Department's Bureau of Economic Analysis is needed. There are two important types of multipliers, one which is a based on the monetary value of the finished product, and the second, which is based on the contribution to employment in other sectors of the economy (Milken Institute, 2002). The multiplier is calculated for each industry and business sector's output as a measure of the effects that a sector has on other sectors of the economy, both as input and output (Joel Popkin and Company, 2003). These inputs and outputs include almost every kind of good and service, from the raw materials that go into the product and the software used to operate equipment, to the transportation of the product, banking and legal services, and health care coverage (U.S. Department of Commerce, 2004). These inputs and outputs create other jobs in the economy (Joel Popkin and Company, 2003).

The product value multiplier for manufacturing was 2.43 at the end of the year 2002. This means that for every $1.00 worth of manufactured product, another $1.43 worth of other products and services were generated (National Association of Manufacturers, 2003e). In comparison, the education and health services sector multiplier is 1.7, which means this sector generates only half of the related economic growth that manufacturing does in the economy.

The jobs created by one million dollars worth of manufactured products support approximately 14 workers; 8 in the manufacturing sector and an additional 6 in other sectors of the economy (National Association of Manufacturers, 2003e). Other sectors of the economy may generate more jobs because they are more labor intensive, but when comparisons are made, the lower multiplier effect of those sectors must be considered. One comparison could be made with the service sector. Although each one million dollars worth of sales supports 16.5 workers, 13 of those jobs are in the service sector and only 3.5 are in other sectors (National Association of Manufacturers, 2003e). This is also an indicator of the higher productivity value of manufacturing jobs as opposed to those in the service sector, and also helps provide justification for the higher wages that can be paid as a result of productivity.

Productivity increases are the result of innovation; not only in the manufacturing sector, but also in other sectors of the economy, such as agriculture and banking (U.S. Department of Commerce, 2004). Innovation, which can be major or incremental, allows new products to be created and improvements to be made in existing products. In the U.S., the manufacturing sector has been the leader in innovation through research and development. From the end of World War II until about 1980, the defense department was the lead investor in research and development in the U.S. and was instrumental in the growth of the manufacturing industries (U.S. Department of Commerce, 2004). Since the 1980's, private manufacturers have been the primary investors in research and development in the U.S., contributing to more than 60% of research and development investments in 2002 (Joel Popkin and Company, 2003).

There are several ways that innovation, as the result of research and development, has allowed manufacturers to increase production. Among these are technologies that led to automated equipment, computers and software, and information technologies such as the Internet, which has facilitated supply chain efficiency (Tassey, 2002).

In 2001, California's manufacturing industries generated $164 billion to the state's economy, the highest monetary contribution of any state in the U.S. (National Association of Manufacturers, 2003d). The Milken Institute conducted a study for the California Manufacturers & Technology Association in 2002 that examined the impact of manufacturing on the state economy and major metropolitan areas. Recognizing that the entry into the 21st century is considered a knowledge-based society and is no longer an industrial society, the study questions the ability of a society's economy to be based only on a conceptual knowledge without the application of that knowledge (Milken Institute, 2002). Researchers state that, "Without some form of manufacturing base, product innovation will be limited" (Milken Institute, 2002, p. 36). Another report conducted for the National Institute of Standards and Technology contends that a nation's economy cannot have long-term growth based only on knowledge-based services (Tassey, 2002). The ability to conduct non-tangible services globally allows any nation to acquire the skills, equipment, and personnel to compete for the market share of those services. For long-term economic growth, research and development efforts in the U.S. must be increased for manufacturers to apply technology to their operations and to produce new and innovative products (Tassey, 2002).

Although manufacturers are responsible for the majority of research and development investments in the U.S., total world share of investments by the U.S. have

decreased from over 60% in the 1960's to approximately 30% in 2003 (U.S. Department of Commerce, 2004). This tends to indicate that other nations are recognizing the value of research and development and how it relates to technological advancements and economic growth (U.S. Department of Commerce, 2004). To remain competitive in the global market, manufacturers must continue to innovate and increase productivity.

As a result of manufacturing productivity increases of over 100% between 1977 and 2002, a greater variety of products of high quality are available to consumers at a low cost (U.S. Department of Commerce, 2004). The ability of consumers to purchase goods for less money makes each dollar earned have more purchase power. In addition to more variety of goods, the quality of products and automobiles has improved (Joel Popkin and Company, 2003).

Manufacturing jobs have typically been available for persons of various educational and social backgrounds (U.S. Census Bureau, 2000), and have provided a means to the middle class for millions of people (Milken Institute, 2002). The availability of these well-paying manufacturing jobs has created a higher standard of living for employees and their families (U.S. Department of Commerce, 2004).

The compensation for persons employed in manufacturing jobs, including wages and other benefits such as health insurance, overtime, and retirement contributions (U.S. Department of Commerce, 2004), has been approximately 20% higher than the national average for other job sectors. The average annual compensation for manufacturing employees is $54,000 as compared to the national average of $46,000 (National Association of Manufacturers, 2003e). With the exception of the government sector, manufacturing sector employers are the most likely to offer health insurance benefits to

their employees, with 84% of workers receiving benefits in 2001 (National Association of Manufacturers, 2003d). Of those manufacturing employers who belong to the National Association of Manufacturers and responded to their survey, 97% offered health benefits. In addition to health insurance benefits, a majority of manufacturers offer retirement accounts, life insurance, and dental insurance to their employees. In comparison, less than 75% of employers in each of the other sectors of the economy offer health care benefits (National Association of Manufacturers, 2003d).

Other contributions that manufacturers make to economic growth are at the state and local levels. When manufacturers locate in a community, they pay taxes, purchase real estate, contribute to insurance and other financial companies, and provide well-paying jobs (Joel Popkin and Company, 2003). In addition, they often contribute to research and development and exports of goods.

Information technologies, communication networks, transportation, and utilities are all parts of the infrastructure that is driven by manufacturers. In turn, these spur demand for manufacturers, creating necessary relationships between them and resulting in improvements in all of the sectors (Joel Popkin and Company, 2003). Manufacturers have increasingly been using computers to engage in e-commerce, to order supplies and materials, for shipping and tracking, for sharing files and information, and for operating equipment (U.S. Department of Commerce, 2004). Productivity demand drives the need for continual innovation and updates of the technologies and infrastructure, which in turn, benefits all consumers (Joel Popkin and Company, 2003).

Although the U.S. is the world's leading exporter of manufactured goods, it has a deficit between the amount of goods it imports and those it exports. Part of the cause of

the trade deficit is due to currency exchange rates that are undervalued in comparison to the U.S. dollar (Joel Popkin and Company, 2003). For the U.S. to remain competitive in the global trade market and to decrease the deficit by exporting more goods, the manufacturing sector will have to remain a strong and viable component in the U.S. economy. There currently is no sector in the U.S. economy that can offset an economic loss if the export of manufactured goods declines significantly (Joel Popkin and Company, 2003).

Manufacturing Decline

Through much of the 20th century in the United States, the percentage of people employed in the manufacturing sector had steadily increased, reaching a peak in the late 1940's of approximately 32% of total employment (Forbes, 2004). While manufacturing employment increased, the number of persons employed in agriculture declined sharply. At the beginning of the 20th century, agricultural employment was 38% of total employment, but is now less than 3% (U.S. Department of Agriculture, n.d.). Although agriculture will always be an important sector of the economy, improvements in productivity through mechanization, biological, and technological advancements resulted in the need for fewer persons to be employed in this sector. Manufacturing will also always be an important sector of the nation's economy, but the share of employment in this sector has experienced a sharp decline in recent years and now accounts for only about 11% of the nation's total employment (U.S. Department of Commerce, 2004). The sectors of employment that are increasing are health, professional, and service industries.

When discussing percentages and the employment sector, it is important to be

cognizant of the fact that percentages don't always adequately relate to the actual numbers of persons in a sector. As the percent share in a sector rises, if the total population also increases, the percentage in another sector may decrease, while the actual number of persons in that sector may remain relatively stable.

During the 20th century, manufacturing employment experienced periodic rises and declines, often associated with economic recessions. Manufacturing employment reached a high in 1978 of approximately 19.5 million persons (Congressional Budget Office, 2004) and then declined during recessions in the early 1980's to less than 17 million. The latest manufacturing employment high of just over 18.8 million (U.S. Department of Labor, Bureau of Labor Statistics, n.d.a) was reached in 1998 and then a sharp decline in this employment sector began. As of January 2004, the number of manufacturing jobs was 14.3 million (Congressional Budget Office, 2004). The United States entered another recession in mid 2001 that theoretically ended in November 2001. After past recessions, recovery has included an increase in manufacturing employment; but with each recession and recovery, the high points in the number of people employed in manufacturing have decreased (Congressional Budget Office, 2004). Since the recession ended, there has been a decline of more than 2.8 million manufacturing jobs, a decline of 16.5% (U.S. Department of Labor, Bureau of Labor Statistics, n.d.a) and nearly 24% since the 1998 manufacturing employment peak. While the economy is slowly recovering from the recession in 2001, the expected rise in employment has not occurred (U.S. Department of Commerce, 2004).

There are many reasons for the decline in manufacturing employment and it is interesting to note that although employment in manufacturing has decreased since the

last recession, productivity of manufacturers has increased by 9.7% (U.S. Department of Commerce, 2004). This increase in productivity is partly a result of manufacturers using systems operated by newer technologies such as robotics and computer numerically controlled machinery, and communication technologies that allow rapid transfer of information and data. The use of technology means that fewer people are needed to work in production jobs and those jobs that remain require more highly skilled workers (U.S. Department of Commerce, 2004).

Globalization has allowed the United States and other countries to produce high quality goods at a lower cost. For the manufacturers in the U.S. to remain competitive, cutting production costs and having low cost suppliers of parts has been crucial to their success. Other countries that have lower wages, such as China, Mexico, and India, can do labor-intensive jobs more economically for U.S. manufacturers. Technological advances, a large supply of educated workers, wages that are very low, and undervalued currency have enabled countries such as China to create manufactured goods at a much lower cost than the United States and other industrialized countries. This competition has forced manufacturers in the U.S. to implement lean manufacturing techniques, which are processes that reduce waste and redundancy, increase productivity and quality, and require fewer low skilled production workers (U.S. Department of Commerce, 2004). The textile (National Cotton Council of America, 2001), footwear, and furniture industries in the U.S. have faced competition from other countries that can produce and export goods at a lower cost (Coble, H. & Watt, M. L., 2003). The automotive industry and primary manufacturers of metal products are also outsourcing to other countries and taking advantage of the increased profits to be made by using workers who work for a

fraction of the pay that workers in the United States require (Keller, M., 2003).

Another reason for the decline in manufacturing sector jobs has to do with the outsourcing of service sector jobs by manufacturers. To reduce costs associated with benefits and wages, more manufacturers are eliminating in-house cleaning, cafeterias, accounting, and other service and professional jobs, and outsourcing them to private companies (Bartlett, 2003).

Employers in the United States have also been troubled by the rising costs of health care for employees. According to the National Association of Manufacturers, the manufacturing sector is the second highest provider of health care benefits with 84% of companies providing coverage to their employees in 2001 (2003d). Manufacturers cite escalating health care costs as a major issue that they face, but they feel that offering these benefits help retain employees and are important to attract new employees (National Association of Manufacturers, 2003d).

Manufacturers have compensated workers with wages and benefits 20% higher than the average (U.S. Department of Commerce, 2004). Historically, manufacturing has provided high wage jobs even for persons without post-secondary educations and for those without high school diplomas. In the year 2000, 53% of manufacturing workers aged 18 to 64 had a high school diploma or less education (U.S. Census Bureau, 2000). In 2002, data from the U.S. Census Bureau (2002) indicated that workers with a high school diploma or less education lost nearly 1.3 million jobs. When manufacturers outsource production and operations to other countries, these unskilled workers are left without the high wages and health care benefits they enjoyed for years and often find themselves qualified only for low-skilled jobs without health care benefits. Without retraining, the

jobs they find are very likely to be in the low-paying service sector. It is highly unlikely that the manufacturing jobs that have been lost will return. The decline of lower skilled manufacturing jobs will continue.

The reports regarding the percentage of gross domestic product that manufacturing accounts for in the United States vary from between 14%, as stated in the U.S. Department of Commerce report (2004), and 22% as an averaged percent from the National Association of Manufacturers report (2003c). These differences in percentages are the result of how each has classified manufacturing as a percent of GDP and how the data was calculated as an average over a period of several years. The service sectors and professional sectors of the nation's economy are increasing; however, in 2003, the Bureau of Labor Statistics changed the classification system from SIC to NAICS, thereby changing many jobs that had been classified as manufacturing to other categories such as service-related classifications. Manufacturing employment data tabulated from the U.S. Department of Labor, Bureau of Labor Statistics, prior to 2004 will differ by more than one million when compared to data tabulated after 2004. This change in the classification system was implemented to reflect a more accurate record of the types of jobs in the United States. Prior to 2003, all jobs that were in a manufacturing facility were classified as manufacturing, when in fact there were many that were another type of job such as janitorial. As a whole, the United States is not as dependent on manufacturing for producing income as some individual states are, but it is still a very important sector in the economy (U.S. Department of Commerce, 2004).

Some economists state that the decline of manufacturing jobs is not a problem for the economy and is a healthy condition reflecting the increased productivity of

manufacturers (Bartlett, 2003). If productivity was maintained at the same rate per person and the number of manufacturing workers did not decrease, manufactured goods would far exceed the demand. However, for the economy of some states to remain healthy, job growth in sectors other than the lower paying service and retail sectors must increase (Wisconsin Technology Council, 2002).

Economic Crisis in Wisconsin and Post-Secondary Education

The Corporation for Enterprise Development gives states a yearly report card and an overall rating in three categories: performance, business vitality, and development capacity. Wisconsin received an A for performance in 2003 and has since 1991. This category includes grades for quality of life, equity, employment, earnings and job quality, and resource efficiency (Corporation for Enterprise Development, 2003b). Although Wisconsin's 2003 grade for employment was a D, the overall rating still remained an A. Press releases from the Wisconsin Department of Commerce in 2000 and 2001 comment on these grades. In the press release for the year 2000, the state boasts that Wisconsin has created "more manufacturing jobs than any state but Texas" (Wisconsin Department of Commerce, 2000, ¶ 6). The following year, Wisconsin Governor Mc Callum cited the reason for the high scores as the result of the state's economic diversity (Wisconsin Department of Commerce, 2001). Although Wisconsin has a strong performance rating, there are forces at work undermining economic strength and the quality of life for families. The same study that rated the states indicated a gap between the apparent high performance of states and the realities of the families that reside in the states (Corporation for Enterprise Development, 2003a). While some economists have cited the rise in

productivity as evidence of the United State's economic strength, they have failed to recognize the negative effects that a decline in unit labor costs has on American families. Reduced unit labor costs reflect more goods being produced with a reduction of manufacturing workers. Those lay-offs of manufacturing workers means they have less income, less health insurance coverage, and a lower quality of life (Corporation for Enterprise Development, 2003a). Economies are not merely corporations and profits; they are people and jobs that require a living wage.

High performance ratings did not equate to healthy state budgets for Wisconsin; years of spending in excess of its revenue income had resulted in a budget deficit for the state. The structural deficit that Wisconsin had to address in 2002 and 2003 was held off in the late 1990's by a high rate of economic growth and the use of tobacco settlement dollars, but that was a short-term solution to a much greater problem (Reschovsky, 2002). Wisconsin's problems started in the mid 1990's when the state committed to funding two-thirds of public schooling and increased funding for corrections due to inmates serving longer sentences for crimes. If the state had decreased funding for other services, there may not have been a problem, but funding was maintained in other areas. The basic structure of the state budget was the cause of the deficits. Without change, professor and economist, Andrew Reschovsky predicts Wisconsin will face structural deficits through the year 2010 (Reschovsky, 2002).

In October 2002, a fiscal policy report was released for the third Wisconsin Economic Summit in Milwaukee, WI. The nine persons contributing to the paper analyzed and suggested solutions to the impending deficit crisis facing Wisconsin for the 2003-2005 biennium. Three solutions that were identified were economic growth,

spending cuts and service reductions, and increasing revenue (Wisconsin Economic Summit III, 2002). According to this report, Wisconsin was facing a budget deficit of $2.8 billion, which was the largest in the United States by percentage. Unfortunately, the best solution was the one that could not be achieved in time to reduce the deficit for the next biennium. That solution was economic growth.

When Wisconsin Governor James Doyle took office in 2003 and delivered his Budget Address, the state's deficit was calculated to be $3.2 billion for the 2003-2005 biennium (2003b). Governor Doyle's budget proposal included cuts in state spending and reducing funding to the University of Wisconsin system, while preserving health care benefits and funding to K-12 education. One year later, Governor Doyle presented his 2004 State of the State Address, in which he stated that the budget was balanced and Wisconsin was on the road to economic recovery (2004). Recognizing the importance of the manufacturing industry to Wisconsin, Doyle recommended the passage of the Manufacturing Competitiveness Program, which would be a collaborative effort between "universities, technical colleges and manufacturing extension partnerships to help manufacturers become more competitive" (2004, ¶ 106). This program would provide an investment of $10 million for grants to manufacturers so they could increase their global competitiveness through improved productivity (Doyle, 2003a).

Wisconsin's manufacturing sector was responsible for generating 20% of the state's income (Wisconsin Department of Commerce, n.d.), but the state lost 18,000 manufacturing jobs in 2003 (Wisconsin Department of Revenue, 2004a), and has lost approximately 82,000 jobs between January of 2001 and the end of 2003 (U.S. Department of Labor, Bureau of Labor Statistics, n.d.b). This reflects a decline of 14%

since 2001 and because Wisconsin's economy is more dependent on manufacturing for generating income than most states, the decline of employment in this sector has become a major concern for the state. According to the Wisconsin Department of Revenue 2004 Wisconsin Outlook, manufacturing accounted for an 18.4% share of the states total employment (2003).

Manufacturing in Wisconsin includes many different types of industries producing durable and non-durable goods. Some of the types of manufactured goods are wood products, leather products, textiles, furniture, and fabricated metal products. Historically, Wisconsin has specialized in fabricated metal products, with a large concentration of machinery manufacturer's in the southeast area of the state (Nichols, 2000). The fabricated metal industries in Wisconsin were particularly hard hit by declines in employment due to outsourcing, the high value of the American dollar, and increased productivity as a result of automated machinery. According to Nichols (2000), declines in manufacturing employment do not reduce the importance of manufactured products or the value of those products as a share of the gross domestic product.

In addressing the challenges that Wisconsin faces in the future, education and an educated workforce play a prominent role. As identified by the fiscal policy report prepared for presentation at the Wisconsin Economic Summit III, the best way for Wisconsin to prevent budget deficits is through economic growth. In *Grow Wisconsin*, Governor Doyle's plan to create jobs, attracting companies to the state and thus fostering economic growth, can best be achieved by providing "an abundant supply of talented, highly skilled, highly motivated workers" (Doyle, 2003a, p. 27). Two of the initiatives in the *Grow Wisconsin* plan are to invest in people and Wisconsin businesses. As part of

both investing in people and in business, the plan recognizes the value of collaborative relationships between universities, technical colleges, and manufacturing outreach centers for educating and training workers. The Wisconsin Technical College and University Systems are encouraged to improve transfer agreements between them so that redundancies in the state's education system are minimized and students who wish to transfer would not have to repeat courses (Doyle, 2003a). Federal funds will be directed to industry sectors such as manufacturing to upgrade the skills of workers so they may obtain or continue to be employed in better paying jobs. Grants from a $10 million fund will be made available to at least 50 manufacturers for training and other resources required to improve their productivity. As further evidence of Governor Doyle's commitment to improve conditions for manufacturers in the state, the Department of Commerce is expected to contribute 75% of available training funds to manufacturers (Doyle, 2003a).

Future Worker and Skills Shortage

When companies are looking at areas to locate their businesses, they consider the demographics of the population (Doyle, 2003a). These demographics include the labor force participation rate of persons aged 16 and older, projected population growth of the area in the future, the education level of the potential workforce, and projections of the availability of a workforce (Wisconsin Department of Workforce Development, 2004a). Low unemployment rates, high current labor force participation rates, low potential growth, and low educational attainment levels may negatively influence the decision of companies to locate in an area. Areas that lack the ability to grow or to increase the labor

force participation rates could be economically disadvantaged in the future (Employment Policy Foundation, 2001).

Studies and predictions that are based on demographics and employer surveys suggest that there could be a significant shortage of workers participating in the workforce after 2010 in some areas of the United States (National Association of Manufacturers, 2003b). There are two ways in which populations in any area increase; these are natural increases, where the birth rate exceeds the death rate, and migration from other areas. Ethnically diverse areas tend to have higher birth rates than areas where the populations are predominately white and non-Hispanic white (U.S. Census Bureau, 2003). Those areas where populations have less diversity do not have the ability to grow their populations by natural increase alone and must rely on migration into their area from other areas. United States Census Bureau data indicated that natural population increases between the years 2000 and 2002 in the United States accounted for 53% of the nation's growth, with migration from other countries accounting for the other 47% (Wisconsin Department of Workforce Development, 2004c).

The indications of a potential workforce shortage are based on the fact that the population of the United States is aging (U.S. Census Bureau, 2001a) resulting in more persons leaving the workforce, and that the economy will grow (Su, 2004), requiring more workers than there will be workforce replacements. In 2000, the population aged 65 and older in the United States was less than 12.6%; by the year 2030, persons aged 65 and older will account for 20% of the population (U.S Census Bureau, 2001a). The baby boomers, those persons born between the years of 1946 and 1964, are expected to retire in large numbers by the year 2020. When the baby boomers retire, they will maintain or

increase their demand for services related to health care, recreation, and conveniences (Wisconsin Department of Workforce Development, 2004c). Current predictions raise the concern that the next generation of workers, those born in the mid-1960s to 1980, will not have numbers large enough to compensate the workforce for the large number of workers who will retire. This implies a potential workforce shortage in the United States. Predictions regarding the shortage of workers vary from six million to more than ten million persons (National Association of Manufacturers, 2003b).

Contrasting the prediction that large numbers of baby boomers expect to retire are studies conducted by the American Association of Retired Persons in 1999 and 2004. These surveys found that more than three-quarters of baby boomers plan to work at least part-time after they reach retirement age (AARP, 2004). The situation may not be as gloomy as predicted if retiring baby boomers continue to work and devote time to community service and volunteer activities in retirement, which 51% of those surveyed plan to do (AARP, 2004).

While there may or may not be a shortage of workers in the United States in the future, there is current evidence that there is a shortage of workers with the skills that businesses and industries need. Predictions are that the shortages of workers with necessary skills will continue to proliferate in the future because many workers over the age of 45 are employed in important occupations and as they retire, younger workers will not be able to replace them (Dohm, 2000).

In 2001, shortages of skilled workers were being experienced by several employment sectors including healthcare, construction, and skilled craft trades

(Employment Policy Foundation, 2001). It was predicted that the future shortages of workers would be in the careers that required higher skills and post-secondary education.

Dr. Beth Buehlmann presented testimony to the United States House of Representative's Committee on Education and the Workforce expressing the need for better workforce education to meet the needs of businesses in the 21st century (2003). Citing the results of three employer surveys, Buehlmann reported that the majority of respondents were unable to find qualified workers. In 2001 and 2002, the surveys indicated that no fewer than 70% of the employers could find workers with the skills required to meet their needs. In 2003, the survey results regarding the percentage of employers who could not find workers with the right skills was about 50%. Buehlmann contends that due to the demographics of the aging workforce, even with economic rises and falls, the skills shortage will be an acute and serious issue in the future (Buehlmann, 2003).

As the economy showed signs of recovery and manufacturing started adding workers again in the first quarter of 2004 (Wisconsin Department of Revenue, 2004b), indications of shortages of skilled workers in manufacturing careers started becoming evident. In June 2004, the Salt Lake Tribune reported that employers in Utah and the nation are having difficulty finding skilled machinists to fill open positions. As orders for machine tools increase and business picks up for employers, the number of openings for machinists is expected to increase (Chandler, 2004). The reporter quotes the president of the National Tooling and Machining Association, Matthew B. Coffey, as stating, "there is a skills gap from the past three years that will be with us for the next five" (Chandler, 2004, p. B7).

In a recent issue of USA Today, reporter Barbara Hagenbaugh cited a survey conducted by the Federal Reserve Bank of Philadelphia of Mid-Atlantic manufacturers that found the majority of respondents had difficulty finding workers that were qualified (Hagenbaugh, 2004). More than three-quarters of the employers reported applicants lacked the necessary skills to operate production machines or tools.

The United States Department of Commerce conducted roundtable discussions with manufacturers in 2003 and the issue was raised regarding the importance of maintaining a skilled workforce (2004). Manufacturers expressed concern about their inability to find workers with the skills they needed and stated that while workers once did not need post-secondary education, with today's modern equipment, that is no longer the case. The technical skills needed for entry-level jobs now require training beyond what students learn in high school. The report states that worker skills and education will be a dominant factor in America's ability to compete in the global economy (2004).

When comparing the age of persons employed in manufacturing jobs with the other employment sectors, there are fewer persons under the age of 30 in manufacturing than in other careers (Joel Popkin and Company, 2003). Because the number of entry-level job openings in manufacturing careers is declining (Joel Popkin and Company, 2003) and the manufacturing jobs today are more technology intensive and employees in those jobs require higher skills than in the past (National Association of Manufacturers, 2003b), there is a chance that as older workers retire, there will not be enough younger replacements with the skills needed by manufacturers (Joel Popkin and Company, 2003). In a study conducted by the NAM, more than 80% of manufacturers responded that they had a shortage of skilled workers (2003b). The areas where manufacturers reported the

most severe shortages were in the production, engineering, and skilled craft categories. Smaller companies were affected more than larger companies and reported they had difficulty keeping up with productivity needs because they could not find workers for second and third shifts.

According to Wisconsin Governor James Doyle, "Wisconsin will be faced with a significant labor shortage in ten to fifteen years" (2003a, p. 15). This statement is supported by data from the Wisconsin Department of Workforce Development's county workforce profiles. The average labor participation rate in the United States is approximately 66% (Bureau of Labor Statistics, 2004) and Wisconsin's rate of labor participation in 2002 was 73%, nearly 11% higher than the national average (Wisconsin Department of Workforce Development, 2004c). In the year 2000, Wisconsin had the highest labor force participation rate of all the states in the nation (Winters, 2000). This tends to indicate that residents of Wisconsin cannot contribute much more to workforce participation than they already are. With the start of baby boom generation retirements around 2012, the lower birthrate in most areas of the state, and lower numbers of persons in younger generations, Wisconsin could face a severe worker shortage in the future.

The Wisconsin Department of Workforce Development compiled profiles of each of Wisconsin's 72 counties and calculated projections through the year 2020 for county demographics. These profiles describe the population, commuting patterns, labor force participation rate, average educational attainment, contribution of industrial sectors to the county economy, top employers in the county, and wage data for each county. The projections regarding the future workforce of the counties are based on the assumptions that past and current trends will continue into the future. Current projections indicate that

only 8 of the 72 counties will have sufficient numbers of workers in the future to support the future populations of the counties and possibly be able to support new businesses in those counties (Wisconsin Department of Workforce Development, 2004c). Of those eight counties, four are considered more advantaged regarding having an excess labor force and those four counties have labor force participation rates above 80%. The four advantaged counties are all located in the eastern area of the state near the cities of Appleton and Green Bay and are Outagamie, Calumet, Winnebago, and Brown counties. These four advantaged counties had manufacturing as their primary industry sector and payrolls accounted for nearly $3.5 billion in 2002.

Labor force projections of Wisconsin's counties predict acute workforce shortages in more than 40 counties, with probable shortages in at least 17 counties (Wisconsin Department of Workforce Development, 2004c). Other counties may have sufficient work forces if the labor force participation rates and growth continue as projected. Predictions for several counties indicate that even if there is a supply of workers, there could be a shortage of workers with the skills needed in some occupations.

Factors that could influence Wisconsin's labor force participation rate in the future include the migration of persons near retirement age into areas; the exodus of young people to areas that are more desirable to them; migration into the counties from other counties, states, or countries; and the ability of companies to provide incentives for younger and older workers to participate in the labor force. Predictions are that Wisconsin's labor force participation rate will decline in the future as the population increases in age (Wisconsin Department of Workforce Development, 2004c).

The future economic prosperity of Wisconsin could be in jeopardy if more workers cannot be enticed to migrate to the state and if educated young persons continue to migrate out of the state (Winters, 2000). Because companies consider the predicted labor force when looking at areas to locate, and there is the potential for labor shortages in most Wisconsin counties, it could be difficult for high-tech companies to justify moving to the state.

Some of the immediate consequences of having a skilled worker shortage are an inability to meet production demands, implement the use of new technologies that could increase productivity, and apply quality improvement processes (NAM, 2001). Without productivity capacity, the ability of manufacturers to compete globally could be hampered and more companies would be forced to move operations to other countries or to cease operations altogether (Employment Policy Foundation, 2001).

Further consequences of a skill and labor shortage could result in a decline in the standard of living for Americans (Employment Policy Foundation, 2001). The socioeconomic gap between the more financially secure and the lower income populations could increase. Those populations that are most likely to be adversely affected would be the elderly and minority. Inflational increases in the wages for persons in the career fields with the greatest shortages and highest demand is likely to occur (Employment Policy Foundation, 2001).

There is evidence that the skills shortage predictions are becoming a problem in Wisconsin. An article by Joel Dresang of the Milwaukee Journal Sentinel quoted a machining plant manager in the Milwaukee area as saying that he had difficulty finding qualified workers, and an interview with a staffing agency president was quoted by

Dresang reporting an increased demand for "skilled trade workers" (Dresang, 2004, ¶ 11).

The Wisconsin Technical College System held 12 business roundtable discussions in locations throughout Wisconsin in the fall of 2003. Among the concerns that business and industry leaders felt would be a challenge in the future, 41% cited a shortage of skilled workers (Wisconsin Technical College System, 2004a).

In June 2004, a state-called meeting was held by the Wisconsin Technical College System to discuss the core skills needed by manufacturers. During a panel discussion with Wisconsin industry experts, Dan Conroy of Nexen Corporation and Sherrie Hein of D & S Manufacturing stated that they found it hard to find employees with the skills their companies needed (personal conference attendance, June 3, 2004). Both stated that the workers they had difficulty finding were machinists.

Additional evidence that Wisconsin could be facing a skilled worker shortage was revealed by the results of the annual survey of the Wisconsin Manufacturers and Commerce Board of Directors. Nearly one-third stated that they were having difficulty finding employees, up from 6% one year ago. The majority of those having difficulty stated that a lack of qualified applicants was the reason, and 20% stated that the field in which they were having trouble was in the machinist field. Others indicated they had difficulty finding qualified labor in all fields, professional, and unskilled labor (Wisconsin Manufacturers and Commerce, 2004).

The Employment Policy Foundation proposed three solutions to the predicted labor shortages. The solutions are increasing the labor force participation, increasing immigration into the United States, and maintaining the productivity levels of employers

(Employment Policy Foundation, 2001). Wisconsin's Department of Workforce Development, in its county profiles, also suggests raising the participation rates of older workers who may opt for retirement and to increase the participation rates of youth in some counties (Wisconsin Department of Workforce Development, 2004c). In addition, it is suggested that employers provide incentives to retain workers, particularly older worker. But even increasing the labor force participation rate of older persons in some counties will not be enough to prevent labor shortages (Wisconsin Department of Workforce Development, 2004c).

Technology that allows unattended production and an increase in immigration could decrease the predicted worker shortage, but there are still indicators that there will be a skilled worker shortage (National Association of Manufacturers, 2003b). These shortages could prevent the US from staying competitive in the global market. For increased and maintained productivity of businesses and industries, an educated and more highly skilled workforce will be needed (National Association of Manufacturers, 2001). The U.S. Department of Commerce report states, "Educational institutions must respond by giving every American the tools to prosper in the global economy" (2004, p.51). According to the National Association of Manufacturers report, Keeping America Competitive, manufacturers prefer two-year, post-secondary colleges for training their workers because of the ability of these institutions to respond to their needs and provide flexible options for training (National Association of Manufacturers, 2003b).

Wisconsin Technical College System and Manufacturing

Throughout the 20th century, two-year post-secondary vocational, technical, and community colleges have served an evolving role to meet the needs of students and local industries (U.S. Department of Education, 2004). Today, these colleges prepare people to work in every major business and industrial sector of the economy and employers rely on these facilities to provide training for their workforce. The technical, vocational, and community colleges are the main source of education for the workforce in the United States (Gunderson, S., Jones, R., & Scanland, K., 2004).

Community and vocational education colleges offer both academic and vocational credit and non-credit courses (U.S. Department of Education, 2004). Vocational offerings primarily provide industry specific training. Depending on the goal of the student, academic and vocational programs can lead to a certificate, diploma, or an associate degree. However, not all students attend community and vocational colleges with the intention of acquiring a credential. The reasons that individuals choose to attend vocational colleges include upgrading their skills so they can perform their jobs better, personal enrichment, learning new skills to change careers or advance in their current careers, and to prepare for transfer to colleges that offer baccalaureate degrees.

While more than two-thirds of the students in the United States who attend post-secondary vocational schools with the intention of completing a program that leads to a certificate or associate degree do not earn any credentials, they earn more than their counterparts with only a high school diploma (U.S. Department of Education, 2004). However, this difference applies to males and not females. Females must attain a

certificate or associate degree to earn more than they would with only a high school diploma. Both males and females tend to earn substantially more than they would with only a high school diploma when they complete a vocational program (U.S. Department of Education, 2004).

Vocational education provides educational opportunities to student populations that are very diverse and which tend to be older than student populations at baccalaureate colleges (U.S. Department of Education, 2004). Students enroll and take courses for a variety of reasons. Data from 1996 indicated that among students over the age of 24, obtaining job skills was stated by more than 43% as their primary goal. The goal of a achieving a certificate or degree accounted for 20% to 26% of the responses of all age groups. Between 33% and 37% of students under the age of 23 stated their primary objective was to attain transfer credits. With these diverse populations and goals, the post-secondary vocational colleges have been flexible to respond to the needs of students and the industries that rely on them to provide job skills (U.S. Department of Education, 2004).

According to Richard Carpenter, president of the Wisconsin Technical College System, the district colleges are "designed to respond rapidly to meet the needs of our business and industry" (Carpenter, 2003). In turn, this is helping the economic recovery of Wisconsin. The college provides technical skills to graduates who will be employed by industries and to current employees of companies so they can be more competitive. The technical college systems also provide training for displaced workers and for those workers who need to upgrade their skills. The placement rate of graduates of the Wisconsin technical colleges six months after completing their programs is 94%, and

97% of students report an above average level of satisfaction with the education they have received through the technical colleges (Carpenter, 2003).

The mission of the Wisconsin Technical College System Board (WTCSB) is the "initiation, development, maintenance and supervision of programs with specific occupational orientation below the baccalaureate level, including associate degrees, training of apprentices and adult education below the professional level" (Wisconsin Technical College System, 2003a, p. 1). The principal purposes of the system are "to provide occupational education and training and retraining programs, and to provide customized training and technical assistance to business and industry in order to foster economic development and expansion of employment opportunities" (Wisconsin Technical College System, 2003a, p. 1).

The Wisconsin Technical College System Board has relationships with several agencies. By Wisconsin state law, the WTCSB is required to work with the federal government to implement federal acts that relate to technical education. In addition, the technical colleges work with the Wisconsin Department of Public Instruction to make available vocational and technical education for all persons in Wisconsin at both the secondary and post-secondary level (Wisconsin Technical College System, n.d.b). Other systems and agencies that the technical college system works with are the University of Wisconsin System and the Department of Workforce Development.

The Wisconsin Technical College System (WTCS) had its beginnings in 1907 when laws were passed that allowed cities to operate trade schools and to establish technical schools or colleges. Industrial education boards had to be created in all Wisconsin cities that had populations of 5,000 persons or more (Wisconsin Technical

College System, n.d.b). Wisconsin's commitment to industrial education was evidenced by the fact that it was the first state to provide a "system of state aid and support for industrial education" (Wisconsin Technical College System, n.d.b, ¶17).

In 1917, the Smith-Hughes Act was passed, which was the first legislation at the federal level to support vocational education (Wisconsin Technical College System, n.d.b). During the 1930's, as the United States struggled through the depression era, more persons attended Wisconsin's vocational schools. As enrollments increased, the future technical college system administration boards went through several name changes. The State Board of Industrial Education became the State Board of Vocational Education in 1917 and then The State Board of Vocational and Adult Education in 1937. In 1970, after more laws advocating vocational and technical education, the name of the state board was again changed, this time to the State Board of Vocational, Technical and Adult Education. In 1993, the system became the Wisconsin Technical College System and the district schools became technical colleges (Wisconsin Technical College System, n.d.b).

There are 16 Wisconsin technical college districts and in 2003 there were 46 campuses within those districts. The purpose of the districts is to "deliver technical education that meets the needs, interests and abilities of students and of the labor market" (Wisconsin Technical College System, 2003a, p. 5). Because each of the districts are located in different locations of the state and there are varying demographic compositions within each district, programs and course offerings are designed to meet the needs of the local communities. To help achieve this goal, Wisconsin statutes gives the Wisconsin technical college district boards the right to establish advisory committees consisting of representatives of employee and employer members for every occupation in the district

(Western Wisconsin Technical College, n.d.a). As a result of the legislation, the Wisconsin Technical College Board requires every district to have an advisory committee for each occupational diploma and associate degree program.

In the 2001-2002 fiscal year, the Wisconsin Technical College System contributed to economic development in the state by contracting with other economic industry sectors to provide education and training. Of the 4,609 contracts entered into, 72% were with businesses and industries and they created $18.9 million in revenue and provided instruction for 123,568 persons (Wisconsin Technical College System, 2003a). In addition, $4.9 million in revenue was created as the result of 967 contracts with manufacturers and other businesses to provide technical assistance and training related to manufacturing.

According to Wisconsin Governor Doyle, "Wisconsin ranks high on the education of our manufacturing workforce in particular, a tribute to our public schools and technical colleges" (Doyle, 2003a, p. 10). As part of Governor Doyle's Manufacturing Competitiveness Program, Wisconsin's technical colleges work with other organizations and the UW system to help manufacturers obtain the training and resources they need to improve productivity (Doyle, 2003a).

The Wisconsin Technical College Districts provide assistance to manufacturers by working with organizations such as the Northwest Wisconsin Manufacturing Outreach Center (NWMOC), the Wisconsin Manufacturers Extension Partnership (WMEP), the Wisconsin Department of Commerce, Wisconsin Job Centers, the Wisconsin Department of Workforce Development, and the Wisconsin Economic Development Association (Wisconsin Technical Colleges, n.d.b). In addition to these organizations, the districts

offer customized training and other services to employers through their business and industry training staff.

The Northwest Wisconsin Manufacturing Outreach Center serves 33 counties in northern and western Wisconsin and partners with Chippewa Valley, Wisconsin Indianhead, Nicolet Area, Northcentral, and Western Wisconsin technical colleges and the University of Wisconsin Stout campus to provide technical assistance and training to manufacturers (Northwest Wisconsin Manufacturing Outreach Center, n.d.). Small and medium sized manufacturers benefit from services that analyze and help them modernize their facilities to increase productivity.

The Wisconsin Manufacturing Extension Partnership partners with the Wisconsin Technical College System to provide technical training to manufacturers in 39 Wisconsin counties (Wisconsin Manufacturing Extension Partnership, n.d.). Both the NWMOC and WMEP are non-profit organizations that are part of the national Manufacturing Extension Partnerships (MEP) network that serve small and medium sized manufacturers to help them obtain technical assistance and training so they can increase productivity and remain competitive. The MEPs are affiliated with the National Institute of Standards and Technology and are funded by federal and state monies, along with local and private sources (National Institute of Standards and Technology, n.d.). In the fiscal year 2003, process improvement was the primary area that the MEPs provided assistance to the nation's manufacturers in and quality and inspection was the secondary area in which assistance was provided. As a result of the assistance provided by MEPs, it is estimated that manufacturing companies saved more than $680 million and that more than 35,000 jobs were created or retained (National Institute of Standards and Technology, n.d.). In

Wisconsin, the NWMOC helped manufactures save nearly $2.5 million, increase or retain $16.1 million in sales, and allowed them to retain or create 78 jobs in the year 2001 (National Institute of Standards and Technology, 2003). The WMEP served 441 manufacturers in 2002 and helped them save more than $23.5 million and increase or retain $90.3 million in sales (Wisconsin Manufacturing Extension Partnership, 2003).

The Wisconsin technical college districts assisted the MEPs by providing training and resources for lean manufacturing processes such as 5S, value stream mapping, Kaizan principles and practices, total productive maintenance, and Six-Sigma (Lakeshore Technical College, n.d.a). The colleges also provided process improvement training such as set-up reduction, ISO quality improvement, statistical process control, and cellular manufacturing (Fox Valley Technical College, n.d.b).

Among manufacturers in the United States, a survey of employers conducted by the National Association of Manufacturers indicated that technical and vocational colleges were their secondary sources for training incumbent workers (2001). The primary source of training for business and industry was that which was provided for employees within their facilities. All 16 Wisconsin technical college districts offer services for manufacturers (Wisconsin Technical Colleges, n.d.b). Some of the courses offered by most of the districts include computer-aided design (CAD), computer-aided manufacturing (CAM), computer-numerical control programming (CNC), electricity/electronics, hydraulics/pneumatics, blueprint reading, geometric dimensioning and tolerancing, industrial math, welding and metal fabrication, machine tool, and precision measurement (Wisconsin Technical Colleges, n.d.b). The four program areas

that typically teach these types of courses are machine tool, electronics, welding, and mechanical design.

Industrial Technology Programs in the Wisconsin Technical College Systems

Wisconsin's technical colleges offer over 300 programs, which are categorized under 12 instructional areas. The instructional areas are Manufacturing and Industrial Technology, General Education, Health Occupations, Architecture and Construction, and Family, Consumer and Related Human Services (Wisconsin Technical Colleges, n.d.a). The Wisconsin Technical College categorizes instructional areas under the divisions of Agriculture, Business and Marketing, Family and Consumer Education, Service and Health, General Education, and Trade, Industry and Technology (Wisconsin Technical College System, 2004c). Each of the 16 technical college districts categorizes their Trade, Industry and Technology instructional offerings under various division headings. Some examples of division headings include Technical and Industrial, Industrial Technology, Manufacturing Technology, and Engineering and Integrated Manufacturing Technologies. Careers in manufacturing industries are found in the Trade, Industry and Technology divisions.

The Trade, Industry and Technology instructional areas include many different programs other than those in the manufacturing sector. The author wanted to evaluate the need for program graduates related to the decline in manufacturing and the perceptions of industrial employers in the manufacturing sector of the economy. The author uses the term *industrial technologies* to categorize the various division names that the 16 technical colleges use for programs that tend to be related to the recent decline in manufacturing

employment. Industrial technology divisions offer the most programs from which industrial manufacturers are most likely to hire graduates. The technical college districts have a mission to provide programs that meet the needs of industries in their districts. Because of this, each district may offer programs that are different from the offerings of other districts. To determine which programs to include in the study, the offerings at each college district was investigated. The programs that were common to most technical college industrial technology divisions were those related to electronics, mechanical design, machine tool, and welding.

In the study conducted for the National Association of Manufacturers, *The Skills Gap 2001: Manufacturers Confront Persistent Skills Shortages in an Uncertain Economy*, manufacturing employers stated that there are many careers in manufacturing that do not require four-year degrees and they felt more emphasis needed to be placed on the value of certificates and two-year degrees (2001). According to the Wisconsin Department of Workforce Development employment projections, 78% of the job openings in Wisconsin through 2010 will not require a bachelor's degree (2003). The credentials that can be attained by individuals at the Wisconsin technical colleges include certificates, one- and two-year diplomas, and associate degrees. Many associate degree program credits at the technical colleges now transfer to four-year educational institutions.

The rest of this section will individually discuss the four industrial technologies programs of electronics, mechanical design, machine tool, and welding. Descriptions of the programs, the districts in which they are offered, graduate statistics, potential occupational careers, the types of industries that hire graduates of each program, and

transfer opportunities will be discussed.

Electronics Related Programs

Electronics-related programs are offered by 14 of the 16 technical college districts. Nicolet Area and Wisconsin Indianhead Technical Colleges, located in the northern part of the state, are the two districts that do not offer these programs. Wisconsin Indianhead discontinued offering electronics-related programs in the year 2002 (Wisconsin Technical College System, Reports, 2004a). Electronics-related programs include Bio-Medical Electronics, Electro-Mechanical Technology, Electronic Servicing, Electronic Servicing Technician, and Electronics.

Bio-Medical Electronics is a two-year associate degree program that prepares graduates to work with health care professionals as advisors and assistants with the electronic equipment used in medical facilities (Western Wisconsin Technical College, n.d.b). The technicians repair and ensure safe operation of the equipment. Careers in this field include Bio-Medical Electronics Technician, X-Ray Equipment Service Specialist, and Clinical Engineering Technician (Wisconsin Technical Colleges, n.d.a). This program is offered at the Milwaukee Area and Western Wisconsin Technical Colleges.

Bio-Medical Electronics had 8 graduates in 1997 (Wisconsin Technical College System Board, 1998), 12 graduates in 2001 (Wisconsin Technical College System Board, 2002), and 14 graduates in 2003 (Wisconsin Technical College System, 2003c).

Electronic Servicing is a one-year technical diploma program that teaches students entry-level skills to maintain and service electronic equipment (Wisconsin Technical Colleges, n.d.a). Lakeshore Technical College, located on Wisconsin's east-

central Lake Michigan shoreline, was the only Wisconsin technical college district offering this program in 2004.

The *Electronic Servicing Technician* program is a two-year associate degree program that teaches students about computer hardware, software, and networking systems so they will be able to analyze and repair problems upon graduation from the program (Wisconsin Technical Colleges, n.d.a). Western Wisconsin Technical College, located in west-central Wisconsin, offered this program in 2004.

The Electronic Servicing and Electronic Servicing Technician programs had a total of 13 graduates in 2003. These two programs have been discontinued or suspended in five districts since the year 2000.

The *Electro-Mechanical Technology* program is a two-year associate degree program offered by 10 Wisconsin technical college districts in the year 2004. This program prepares graduates to work with integrated systems that consist of hydraulics, pneumatics, mechanical systems, electricity, and electronics (Wisconsin Technical Colleges, n.d.a). Examples of these types of systems are robotics, computer-numerically-controlled manufacturing machinery, and other automated systems.

Electronics is a two-year associate degree program, which was also offered by 10 of the Wisconsin technical college districts in 2004. Students learn to troubleshoot, repair, and maintain electronic equipment, including systems used in manufacturing, communications, computers, and computer networks (Mid-State Technical College, n.d.). Manufacturing companies hire graduates to repair and maintain industrial controls, computer controlled systems, and automated machinery (Waukesha County Technical College, n.d.a).

In fiscal year 1996-1997, the Electro-Mechanical Technology and Electronics programs were in the top 25 associate degree programs by the number of graduates of these programs. There were 276 graduates statewide in 1997, but in 2002, the number of graduates in these two programs had declined by 38.7% to 169 (Wisconsin Technical College System, 2003b). Graduates of the Electronics program declined more than 54% in this five-year period. In 2003, there were 185 graduates of these two programs. The increase between 2002 and 2003 was in the Electronics program, with 31 more students graduating. Electro-Mechanical Technology program graduates declined from 100 to 95.

Based on a review of program brochures and literature from the Wisconsin technical college districts that offer electronic-related programs, several of the various careers that graduates can potentially enter are the same for the Electro-Mechanical Technology and the Electronics programs. This seems to indicate that the skills learned in each related program tend to provide transferability to many career fields, regardless of the electronic-related program degree. Examples of several careers listed by the Wisconsin technical colleges that graduates report entering that are common between two or more programs are Electronics Technician, Engineering Technician, Research Lab Assistant, Field Service Technician, Maintenance Technician, and Computer Networking and Telecommunications Field Service Technician (Wisconsin Technical Colleges, n.d.a). Careers listed by the Occupational Outlook Handbook that electronics-related program graduates may enter include Engineering Technicians, Electrical and Electronics Installers and Repairers, and Radio and Telecommunications Equipment Installers and Repairers (U.S. Department of Labor, Bureau of Labor Statistics, 2004).

There are many types of businesses and industries that hire electronics related program graduates. Manufacturers need program graduates for servicing automated industrial machinery and electronic controls, to set up and service computer systems and computer-controlled machine systems (Waukesha County Technical College, n.d.a), and for installing electronic equipment (Madison Area Technical College, n.d.a). The 2003 graduate follow-up report from Fox Valley Technical College lists several of the job titles and employers of students who graduated from the Electronics and Electro-Mechanical Technology programs in 2003 (Fox Valley Technical College, 2004). The types of companies that hired graduates, and the graduate job titles, include the following:

- Manufacturer of arc welding equipment; Degree Tester
- Producer of metal castings for the transportation industry; Electrician
- Manufacturing and packaging service; Maintenance Technician
- Manufacturer of safety equipment; Electrical Designer
- Coated paper products manufacturer; Electrician
- Technical College; Media Service Technician
- Casino; System Technician

Graduates of the two-year associate degree electronics related programs have opportunities for advancing their education by enrolling in four-year baccalaureate degree offering colleges and universities. Articulation agreements for credit transfer exist between the technical college districts and several colleges and universities (University of Wisconsin System, n.d.a). These will be discussed in a subsequent section.

Mechanical Design Technology Programs

Mechanical design technology is a two-year associate degree program. Students in this program learn to use computer aided drafting (CAD) to design and create product drawings. To achieve this goal, they learn to use and apply math, engineering principles, and manufacturing technology to design the products (Madison Area Technical College, n.d.c). Upon graduation, many mechanical design technicians work in manufacturing industries to help engineers test and design fabricated metal products, consumer products, and industrial equipment (Moraine Park Technical College. n.d.b).

Occupations that mechanical design technology graduates are employed in include Mechanical Designer, Drafting Technician, Drafter, Technical Report Writer, Engineering Assistant, and Product Designer (Wisconsin Technical Colleges, n.d.a). With additional education, there are many opportunities for advancement. Some occupations that require additional education include Mechanical Engineer, Plant Engineer, Production Engineer, and Tool and Die Designer (Waukesha County Technical College, n.d.b).

Mechanical design programs are offered by 15 of the 16 Wisconsin technical college districts. Nicolet Technical College is the one district that does not offer the program; however, as of 2004, Chippewa Valley Technical College is no longer accepting program applicants.

In the year 1997 there were 205 graduates of the mechanical design program. In 2002, the number of graduates had declined to 152 (Wisconsin Technical College System, 2003b) and in 2003 there were 131 graduates, a decrease of 36% in seven years (Wisconsin Technical College System, 2003c). The mechanical design technology

program ranked among the top 25 of all programs in the Wisconsin technical college districts in 1997 and 2002, by graduate count, but fell from 12th place in 1997 to 22nd place in 2002.

In March 2004, the Wisconsin Technical College System convened a meeting to discuss the future of the mechanical design programs in the districts. There was discussion regarding the name of the program and it was decided that the program would be named *Mechanical Design Technology* in all districts (Wisconsin Technical College System, n.d.a). During discussions on a variety of topics, issues were raised regarding the future employment outlook. Attendees questioned whether the job market would be large enough for graduates due to the decline in manufacturing employment and the ability to increase productivity and efficiency by the use of CAD and computer aided manufacturing. The current manufacturing environment in the state of Wisconsin and employer need for graduates was a recurrent theme.

Manufacturers of many types of products hire graduates of Mechanical Design programs to assist engineers, design and draw products and components of products, and to test and inspect equipment (Fox Valley Technical College, n.d.c). The industries that hire graduates include industrial and agricultural equipment manufacturers, paper manufacturers, and metal fabricators (Moraine Park Technical College, n.d.). The 2003 graduate follow-up report from Northeast Wisconsin Technical College (2004) included the following manufacturer descriptions and the job titles of 1998 and 2003 Mechanical Design Technology graduates hired by the companies:

- Manufacturer of automatic vehicle washing systems; Detailer
- Yacht builder; Mechanical Designer

- Metalworking industry; Project Engineer
- Manufacturer of paper industry machinery; Mechanical Designer
- Manufacturer of pump stations and control systems; Engineer
- Manufacturer of electric power generation systems; Engineer
- Manufacturer of metal cookware; Engineer

Graduates of the Mechanical Design Technology programs from the Wisconsin technical colleges have the opportunity to continue their education by enrolling in four-year baccalaureate degree offering colleges and universities. Articulation agreements for credit transfer will be discussed in a subsequent section.

Machine Tool Programs

Machine tool related programs in the Wisconsin Technical College System districts include CNC Technician, Computer Numerical Control Machine Operator/Programmer, Machine Tool Operation, Machine Tool Technician, Machine Tool Technics, Machining Technician, and Tool and Die Making (Wisconsin Technical Colleges, n.d.a).

Fifteen of the 16 Wisconsin technical college districts offer at least one machine tool related program. Nicolet Technical College discontinued offering machine tool related programs in the year 2002 (Wisconsin Technical College System, 2004a).

The *CNC Technician* Program is a two-year technical diploma program that was offered at Blackhawk Technical College in southern Wisconsin and at Northeast Wisconsin Technical College, located in the upper northeastern part of the state. The CNC Technician program is the only machine tool program offered in Blackhawk Technical College's district. Northeast Wisconsin Technical College offers the CNC

Technician program to graduates of the one-year Machine Tool Operation program as a second year of advanced training using computer numerically controlled equipment (Northeast Wisconsin Technical College, n.d.b). Both programs teach students the basics of machine tool operation in the first year and CNC machining in the second year using 4-axis machining and turning centers that utilize computer aided manufacturing (CAM) programming (Blackhawk Technical College, n.d.). Upon graduation, students enter careers as CNC Operators, CNC Machinists, CNC Technicians, and Machinists.

The CNC Technician program is relatively new to the Wisconsin Technical College System and no graduation data exists for the years 1997 through 2002. In 2003, there were 11 graduates of the program (Wisconsin Technical College System, 2003c).

The *Computer Numerical Control Machine Operator/Programmer* program is a one-year technical diploma program that was offered only at Milwaukee Area Technical College in 2004. This program prepares students for careers such as CNC Operators and Machinists (Wisconsin Technical Colleges. n.d.a). Students are taught the basics of computer numerical control programming and operation. There were six graduates of this program in 1997 (Wisconsin Technical College System Board, 1998) and seven graduates in 2003 (Wisconsin Technical College System, 2003c).

Eight Wisconsin technical college districts offered *Machine Tool Operation* in 2004. This one-year technical diploma program provides graduates with basic manual machining skills using lathes, milling machines, surface grinders, and other machine tools. In addition, an introduction to computer numerical control programming was provided (Wisconsin Technical Colleges, n.d.a). Graduates of the Machine Tool Operation program are employed as Machinists, CNC Operators, CNC Programmers,

Machine Tool Operators, Machine Set-Up Operators, Apprentice Tool and Die Makers, and Toolmakers.

In most of the Wisconsin technical college districts that offer Machine Tool Operation and either the Machine Tool Technics or the Machine Tool Technician program, graduates of the Machine Tool Operation program can continue their education and earn a two-year technical diploma in either the Machine Tool Technics or the Machine Tool Technician program.

Machine Tool Operation has been a popular program in the past. In 1997 there were 165 persons who graduated from the program (Wisconsin Technical College System, 2003b) and it was ranked ninth out of the top 25 technical diploma and apprenticeship programs, by graduates, in the Wisconsin technical college system. In 2002, there were 87 graduates, a decline of 47%. Machine tool operation still ranked in the top 25, but had fallen to 21st position. In 2003 there were 49 graduates of this program (Wisconsin Technical College System, 2003c). This represents a 70% decline in graduates of the program over the six year time period.

The *Machine Tool Technician* program was offered by four Wisconsin technical college districts in 2004 (Wisconsin Technical Colleges, n.d.a). This program prepares graduates for careers as Machinists, CNC Operators, CNC Programmers, CNC Machinists, Apprentice Tool and Die Makers, and Toolmakers. Students in the program learn to precisely machine tool components, read blueprints, and do math calculations to set-up and operate manual and CNC machine tools. Emphasis is placed on precision machining and the use of precision measurement devices to inspect parts during and after machining.

Graduation rates for the Machine Tool Technician program have tended to increase since 1997 when there were 23 graduates of this program (Wisconsin Technical College System Board, 1998). In 2003, there were 45 graduates of this program (Wisconsin Technical College System, Reports, 2003c). While the numbers of graduates in this program have increased, they do not compensate for the decrease in graduates that occurred in the Machine Tool Technics program.

Machine Tool Technics was offered by six Wisconsin technical college districts in 2004. This program teaches students to build jigs and fixtures, plastic injection molds, stamping dies, and other precision tools (Northeast Wisconsin Technical College, n.d.c). Students learn to use CAD systems and CAM programming software to create tools in CNC machining and turning centers. Students also learn to set-up and operate electrical discharge machines (EDM) to machine parts and components for tools (Madison Area Technical College, n.d.b). Upon graduation, students enter careers such as CNC Programmer, Machinist, CNC Operator, Mold Maker Apprentice, Tool and Die Maker Apprentice, Electrical Discharge Machining Operator, and Toolmaker Apprentice.

Machine Tool Technics is another program that ranked in the top 25 technical diploma and apprenticeship programs in 1997 and 2002 (Wisconsin Technical College System, 2003b). There were 132 graduates of this program in 1997 and 103 graduates in 2001. In 2003, there were 49 graduates of this program, which represents a 62% decline over the six-year period (Wisconsin Technical College System, 2003c).

The *Machining Technician* program was offered at the Moraine Park Technical College district in 2004. This district is located in southeast Wisconsin and this was the only machine tool related technical diploma program that Moraine Park offered.

However, they did offer a one-semester certificate for *CNC Set-up Operator* in 2004. Students enrolled in the Machining Technician program complete the first year by learning basic manual machining and introductory CNC programming, and building jigs and fixtures (Moraine Park Technical College, n.d.a). In the second year of the program, students select a specialization of CNC or Tool and Die Making. Graduates of the program can enter careers as CNC Operators, CNC Programmers, CNC Machinist, Tool and Die Maker Apprentices, and Mold Maker Apprentices.

Tool and Die Making was offered by Chippewa Valley, Milwaukee Area, and Waukesha County Technical Colleges in 2004. Students enrolled in the two-year Tool and Die Making technical diploma program learn to build jigs and fixtures, molds, stamping dies, and other tools using precision metal working skills (Chippewa Valley Technical College, n.d.). Manual and computer numerically controlled machine tools and CAD/CAM programs are used to create the precision tooling. Careers opportunities available for graduates of the Tool and Die Making program include Tool and Die Maker, Mold Maker, Machinist, CNC Machinist, and Toolmaker.

In 2003, there were 74 graduates of the Tool and Die Making programs (Wisconsin Technical College System, 2003c). This is a decline of just over 23% from 2001, when there were 97 graduates of the program (Wisconsin Technical College System Board, 2002). This program had more fluctuation in the graduate count in the 1997 to 2003 six-year period than other machine tool related programs. In 1997, there were only 20 graduates, but the number of graduates increased by nearly 400% before declining to the 2003 count (Wisconsin Technical College System Board, 1998).

The occupations that graduates of the machine tool related programs might enter are common between programs. This tends to indicate that the skills learned in most of the programs are transferable and are not occupation specific. For example, a diploma in the Machine Tool Technics, Machine Tool Technician, or the Tool and Die Making program will prepare an individual for a career as a Machinist, CNC Programmer, Apprentice Tool and Die Maker, and Apprentice Moldmaker.

Graduates of the machine tool related programs that are employed in careers related to their educational diplomas work primarily in shops dedicated to machining metal products. The graduate follow-up report from Chippewa Valley Technical College (2004) lists the employment information for 2003 graduates and includes employer and job title data. The following list describes several of the types of employers and the job titles of the graduates employed by the company:

- Extrusion die manufacturer; CNC Operator
- Manufacturer of sawmill equipment; CNC Machinist
- Original equipment manufacturer; Machinist
- Extrusion die manufacturer; Machinist
- Manufacturer of precision machined parts; Machinist

Graduates of the Tool and Die Making program at Waukesha County Technical College have opportunities for advancing their education. Articulation agreements exist with UW-Milwaukee and UW-Stout for Tool and Die Making graduates to transfer some credits to bachelor degree programs at these universities (Waukesha County Technical College, 2004).

Welding Programs

All 16 of the Wisconsin technical college districts offer welding-related programs. The programs that are welding-related include Industrial Welding Technician, Metal Fabrication/Welding, Welding, and Welding/Maintenance and Fabrication.

The *Industrial Welding Technician* program is a two-year associate degree program. The two Wisconsin technical college districts that offer this program are Fox Valley and Milwaukee Area; both are located in the eastern side of the state. Students in the Industrial Welding Technician program learn to read and interpret welding codes and procedures; how to set up and operate manual and automated welding processes, including robotics and fabrication equipment (Fox Valley Technical College, n.d.a); and how to program computer numerically controlled welding equipment (Wisconsin Technical Colleges, n.d.a). The potential careers of program graduates include Welders, Steam Fitters, Welding Technicians, and Welding Inspectors. This program graduated 10 students in 2003 (Wisconsin Technical College System, 2003c).

Metal Fabrication/Welding is a one-year technical diploma program that was offered at Fox Valley and Waukesha County Technical Colleges in 2004. Students in this program learn to fabricate metal products by reading and interpreting blueprints; programming, setting up, and operating CNC metal fabrication equipment; and setting up and operating various types welding equipment (Waukesha County Technical College, n.d.c, and Wisconsin Technical Colleges, n.d.a). Program graduates find careers as Welders, Welder/Assemblers, Metal Fabricators, and Welder/Fabricators. There were 11 graduates of this program in 2003 (Wisconsin Technical College System, 2003c).

The *Welding/Maintenance and Fabrication* program also had 11 graduates in 2003 (Wisconsin Technical College System, 2003c). This is a short-term program of one semester. It is offered by Gateway and Lakeshore Technical Colleges, which are both located in the eastern part of the state. Students learn about various welding techniques and upon completion find jobs such as Welders, Brazers, Fitters, and Welding Fabricators (Wisconsin Technical Colleges, n.d.a).

The Industrial Welding Technician, Metal Fabrication/Welding, and Welding/Maintenance and Fabrication programs have had low graduation rates. In 1997, the three programs combined graduated 32 students (Wisconsin Technical College System Board, 1998). In 2001, the number of graduates of the three programs had only increased to 36 (Wisconsin Technical College System Board, 2002).

Thirteen of the Wisconsin technical college districts offer the *Welding* program. This is a one-year technical diploma program that prepares graduates for careers such as Welder/Fitters, Welder/Fabricators, Iron Workers, Pipe Trades Workers, Production Welders, Construction Welders, Welders, and Maintenance Welders (Wisconsin Indianhead Technical College, n.d., and Wisconsin Technical Colleges, n.d.a). Students in the Welding program learn to use manual and semi-automatic welding processes to join metal (Southwest Technical College, n.d.). They also complete coursework in math, metallurgy, and blueprint reading.

The Welding program was among the top 25 programs, by graduate count, of the diploma and apprenticeship programs in both 1997 and 2002 (Wisconsin Technical College System, 2003b). There were 194 graduates of the welding program in 1997, but this declined to 159 in 2002. In 2003, the welding program graduated 173 students

(Wisconsin Technical College System, 2003c). Of all the programs offered by the Wisconsin technical college districts, Welding ranked 14th in 1997 and 20th in 2002 by the number of graduates.

The graduation rate for all four welding related programs in 1997 was 229, and in 2003 there were 209 graduates. This reflects only a slight decline of just over 8% over the six year time period. In 2002, when the number of graduates of the Welding program had declined to 159, the decline was 18% for the five-year span.

There are many types of industries that hire graduates of the welding related programs. These include those that manufacture metal enclosures, paper production machinery, agricultural equipment, and food processing equipment. Data from Northeast Wisconsin Technical College's 2003 graduate follow-up report (2004) lists the following types of employers and the titles of the graduates that were employed by the companies:

- Mechanical engineering and contracting service; Pipe Trades Welder
- Manufacturer of welding positioners; Pipe Trades Welder
- Mechanical contractor; Steamfitter
- Plumbing contractor; Welder/Fabricator
- Ship builder; Welder/Fabricator
- Agricultural equipment; Welder/Fabricator
- Pressure vessel manufacturer; Welder/Fabricator

Some of the Wisconsin technical colleges that offer the Industrial Welding Technician programs have articulation agreements with baccalaureate degree offering colleges and universities. Universities that have agreements with several of the technical

college districts for welding program transfer are UW-Platteville and UW-Stout (University of Wisconsin System, n.d.a).

Credit Transfer Opportunities

There has been an increased interest in expanding the options for graduates of Wisconsin Technical College programs to transfer credits to baccalaureate degree offering colleges. As part of Governor Doyle's initiatives to create jobs in Wisconsin, investment in the education of the workforce will be one step toward economic and job growth (Doyle, 2003a). One of the goals of the Grow Wisconsin plan is to increase articulation agreements between the University of Wisconsin and the Wisconsin Technical College System to avoid redundancy in the education of transfer students.

At the September 2003 Wisconsin Technical College System Board meeting, credit transfer between the UW System and WTCS was discussed. According to the meeting minutes, the associate degree programs offer courses of college-level rigor that could be transferable to universities (Wisconsin Technical College System Board, 2003). It was also stated that technical diploma program enrollment have been declining.

The WTCS Board stated several reasons why more transfer agreements between the UW System and the WTCS need to be articulated. Wisconsin has a lower percentage of adults with bachelor's degrees than the national average and the adjoining states of Illinois and Minnesota and by facilitating transfers between systems, more people in Wisconsin may attain bachelor's degrees (Wisconsin Technical College System Board, 2003). There is also a need for Wisconsin to be able to respond to labor market needs, reduce the possibility that students who transfer between colleges will have to repeat

courses, and recognize the value of the degrees earned by Wisconsin technical college graduates. In addition, according to WTCS Board President Nino Amato, the Wisconsin legislature was likely to enact legislation to advance the transfer process if the UW System and the WTCS did not initiate an agreement. Board members adopted a resolution to facilitate transfer between the UW System and the Wisconsin Technical College System in September 2003 (Wisconsin Technical College System Board, 2003).

Transfer opportunities currently exist for Wisconsin technical college graduates of all associate degree and two-year technical diploma programs to transfer credits to baccalaureate degree offering colleges and universities. Transfer agreements differ for each of the technical college districts; however, UW-Stout allows graduates of all associate degree programs to transfer credits to the Career and Technical Education, Industrial Management, or Service Management bachelor degree programs (University of Wisconsin System, n.d.a). Graduates of two-year diplomas at the technical colleges can transfer credits into UW-Stout's Industrial Management degree program.

UW-Platteville had agreements with 13 of the technical college districts to allow transfer of credits from the Electronics and Electro-Mechanical Technology programs to their Industrial Technology Management (University of Wisconsin System, n.d.a). The associate degree electronics related programs at Gateway Technical College also transfer to UW-Platteville's Technology Education program. Western Wisconsin and Milwaukee Area Technical College's Bio-Medical Electronics program graduates can transfer credit to the Applied Science degree program at UW-Platteville.

In addition to transfer agreements with UW-Stout and UW-Platteville, six of the technical college districts had articulated agreements with other colleges to allow transfer

of credits from the electronics related associate degree programs to baccalaureate degree programs. Some of these agreements existed with Franklin University, Northern Michigan University, Silver Lake College, and the University of Phoenix (Northeast Wisconsin Technical College, n.d.a).

Eleven of the Wisconsin technical college districts that offer Mechanical Design Technology have transfer articulation agreements with UW-Platteville for graduates to transfer credits to the Industrial Technology Management degree program (University of Wisconsin System, n.d.a). Gateway Technical College mechanical design graduates can also transfer into UW-Platteville's Technology Education program. Several other colleges and universities have articulation agreements for credit transfer from mechanical design programs into baccalaureate degree programs at their institutions. These include Capella University, Milwaukee School of Engineering, Franklin University, and Silver Lake College (Lakeshore Technical College, n.d.b). Programs that mechanical design students can enroll in at these colleges include Applied Management, Mechanical Engineering Technology, and Manufacturing Systems Engineering Technology.

In 2004, there were no associate degree programs in the machine tool related programs at Wisconsin's technical colleges. Graduates of these programs who had technical diplomas could transfer some credits to UW-Stout's Industrial Management program (University of Wisconsin System, n.d.a). Tool and Die Making graduates from Milwaukee Area Technical College also had the opportunity to transfer credits to UW-Milwaukee's Engineering or Computer Science bachelor degree programs.

Students who completed Industrial Welding Technology at Madison Area Technical College had several options for transferring credits to UW-Platteville in 2004

(University of Wisconsin System, n.d.a). The programs that they could transfer credits to included Agribusiness, Agricultural Education, Animal Science, and Soil and Crop Science.

Articulation agreements between each of the Wisconsin technical college districts and baccalaureate degree offering colleges and universities are specific for each program, college, and WTCS district. The number of credits that will transfer from the technical college programs to baccalaureate degree programs vary from about 15 to a maximum of 72 (University of Wisconsin System, n.d.b). The percentage of students who transfer from Wisconsin technical colleges is increasing. In fiscal year 2002-2003, Wisconsin technical college student transfers accounted for just under 20% of all transfers into the UW System, an increase of 25% since 1997-1998 (University of Wisconsin System, 2003). As more articulation agreements are drafted and the needs of employers change for employees with higher skills, the ability of students of industrial technology programs to continue their education beyond an associate degree or technical diploma may provide an incentive for high school students and other individuals to enter these career fields.

Wisconsin Employment Projections

Nationwide, employment for manufacturing through the year 2012 is expected to show only a slight annual decline of 0.1% (Berman, J. M., 2004). Although employment will decrease, output is expected to increase by 3.4% per year due to increased productivity through the use of automated machinery and advanced technology.

The manufacturing employment sector is comprised of many different types of manufacturing industries. All manufacturing industries are under North American

Industrial Classification System (NAICS) industry codes 31-33, or the older Standard Industrial Classification (SIC) codes of 20-39 (Wisconsin Department of Workforce Development, 2003). Manufacturing industries are further divided into durable goods and non-durable goods. Examples of durable goods are fabricated metal products, wood products, primary metal products, electronic and electrical equipment, and transportation equipment. Non-durable goods are products that are usually expected to last less than a year and include food products, apparel and textiles, paper and printed products, and petroleum products. Each durable and non-durable goods industry classification is further divided into more specific industry groups and employment classifications follow these groups. For example, fabricated metal product manufacturing is under NAICS code 332 and several of the industries under this classification are "Boiler, tank, and shipping container manufacturing; Machine shops; Machinery manufacturing; Electrical equipment manufacturing; Motor vehicle manufacturing; and Ship and boat building" (Berman, J. M., 2004, p. 64-65). Occupations that fall under the fabricated metal product classification include "Welders, Cutters, Solderers, and Brazers; Computer-Controlled Machine Tool Operators; and Team Assemblers" (Wisconsin Department of Workforce Development, 2003, p. 20-21).

The decline in manufacturing employment through 2012 is not expected to occur in all manufacturing industry classification sectors. Employment in the plastics and rubber manufacturing industries is expected to grow 1.5% annually due to the demand for plastic products in other manufacturing industries, such as computers, medical devices, and automobiles (Berman, J. M., 2004). The manufacturing industries that are expected to have the largest output growth include computer and communications equipment

manufacturing, medical equipment and supplies manufacturing, metalworking machinery manufacturing, and forging and stamping. Due to automation and technology, not all of these industries are expected to experience employment growth. While the manufacturing sector will not have the employment growth that the service sector will have, output growth for manufacturing industries is predicted to be comparable to the output growth of the service sector through 2012 (Berman, J. M., 2004).

Wisconsin's employment in the private sector is expected to grow an average of 1.7% annually between 2004 and 2008 (Wisconsin Department of Revenue, 2004b). Employment in manufacturing during the same time period is expected to increase an average of 1.1% annually. Projections are that there will be 529,300 manufacturing jobs in Wisconsin in 2008. According to data from the Wisconsin Department of Workforce Development for May 2004, there were just over 502,000 persons employed in Wisconsin's manufacturing jobs (2004b). Of these, approximately 70,000 were in industries that produced fabricated metal products, and 69,000 were in machinery manufacturing industries, which represented the largest industries in Wisconsin's durable goods manufacturing sector. In Wisconsin's non-durable goods manufacturing sector, the largest industries are food manufacturing, paper manufacturing, and plastic and rubber product manufacturing. These sectors are responsible for employing nearly 138,000 persons in Wisconsin.

The Department of Workforce Development predicts that employment in the fabricated metal product industries will be 65,600 persons in 2010 (2003). The occupations that will add the most jobs in both the fabricated metal product and the industrial machinery manufacturers categories are "Welders, Cutters, Solderers, and

Brazers" and "Computer-Controlled Machine Tool Operators" (Department of Workforce Development, 2003, p. 20). The number of machinists needed in the industrial machinery category is expected to decline. The electronic and electrical equipment manufacturers are expected to need electro-mechanical technicians, and the transportation equipment industry is expected to add the most jobs in the electrician occupation. The paper manufacturing industry is also expected to need electricians. In the rubber and plastic product industry, welders and persons who can operate computer-controlled machine tools will be needed.

The job outlook for graduates of the electronics-related programs in Wisconsin's technical colleges appear to be favorable. Based on the job titles from graduate follow-up reports and Wisconsin Technical College System program descriptions, most of the electronics related occupations are projected by the Wisconsin Department of Workforce Development to grow or need replacement workers each year through 2010. Wisconsin's Department of Workforce Development projections indicate that an average of 480 electricians, 80 electrical/electronic engineering technicians, 30 electro-mechanical technicians, and 90 electrical and electronics engineers will be needed annually (2003). In addition, approximately 80 electrical and electronic repairers will be needed. More than 700 persons are needed in the occupations in which individuals could begin their education in an electronics related program. While some of these occupations require additional on-the-job training or baccalaureate degrees, individuals learn fundamental skills in the technical colleges and have the opportunity to transfer credits and continue their education in other universities and colleges.

Employment projections for mechanical design program graduates do not appear to be as favorable as those for the electronics programs. Although there are no new job opening predicted for mechanical designers through 2010, there will be a need for replacement workers. There is a predicted need for 100 mechanical drafters each year through 2010, and for approximately 40 mechanical engineering technicians (Wisconsin Department of Workforce Development, 2003). With additional education, mechanical designers could become mechanical engineers or enter other occupations. There is predicted to be a need for 220 mechanical engineers each year through 2010.

The number of jobs for machinists and tool and die makers is predicted to decline in Wisconsin, but there will be the need for an average of 320 replacement machinists and 170 tool and die makers each year through 2010 (Wisconsin Department of Workforce Development, 2003). The only machine tool related occupation that is predicted to grow is computer control programmers and operators. Not only will this occupation grow, replacement workers will be needed. An average of 480 CNC programmers and operators will be needed each year in Wisconsin through 2010. There appears to be need for more than 900 workers annually in Wisconsin that have skills that can be learned in machine tool related programs in the technical colleges.

According to the 2004-2005 Occupational Outlook Handbook, two-thirds of the jobs held by welders are in manufacturing industries (U.S. Department of Labor, Bureau of Labor Statistics, 2004). Wisconsin is predicted to need nearly 600 welders annually through 2010 (Wisconsin Department of Workforce Development, 2003). Welding occupations are expected to grow by 150 jobs per year, with an additional need for 530 replacement workers. While some welding jobs can be learned with a few months of on-

the-job training, the use of automated and more technologically advanced equipment will reduce the demand for less-skilled welders (U.S. Department of Labor, Bureau of Labor Statistics, 2004).

The U.S. Department of Commerce conducted a study to determine the economic and productivity impact of welding. This study was sponsored, in part, by the Department of the Navy and was focused on heavy industrial manufacturing firms such as ship builders, armored vehicle and tank manufacturers, and industrial machinery manufacturers (U.S. Department of Commerce, 2001). The research found that welding contributes substantially to the nation's economy and defense capabilities, but there is a serious shortage of workers with the skills needed to sustain the industries that rely on welders. One of the reasons cited for the shortage of qualified workers "from apprentice welders to engineers," was an insufficient number of "advanced welding education programs" (U.S. Department of Commerce, 2001, p. 2).

Studies Regarding Industry Employer Needs for Program Graduates

Many studies have been conducted of businesses and industries by graduate students with regards to the skills and competencies needed for entry-level positions in those industries that would potentially hire students of post-secondary education programs. However, few studies have been conducted by graduate students to determine the extent to which businesses and industries need employees and the number of openings that will be available for graduates of post-secondary education programs.

Post-secondary colleges generally determine the need for program graduates based on industry focus groups, past and current enrollments, and advisory committee

meetings initiated by administrators, faculty, and division deans (personal communication with Richard Westpfahl, Dean of Industrial Technologies, Western Wisconsin Technical College, July 20, 2004). Other studies have been conducted by the National Association of Manufacturers, the Wisconsin Manufacturers and Commerce, and other industry associations to determine if employers are finding employees to fill their job openings. At UW-Stout, Master of Science graduate students of the Hospitality and Tourism and the Career and Technical Education (formerly Vocational, Technical, and Adult Education) programs have conducted studies to help determine the need for programs based on employer responses.

Nicolet Area Technical College (NATC), in the north-eastern area of Wisconsin, suspended their Hospitality Management program in the year 2000 due to a lack of student enrollments. In 2001, Vicki Mendham-Whitehead (2001) conducted a survey of employers in the NATC district who could potentially hire graduates of the Hospitality Management program. The survey was mailed to employers and there was a 66% response rate. The survey used included selection, Likert-Scale, and comment sections. Additionally, Mendham-Whitehead conducted focus groups in which all participants felt there was a need for the Hospitality Management program at NATC. Particularly interesting to this researcher is the post script that Mendham-Whitehead included in the cover letter for the survey stressing the importance of a response to ensure validity.

In 2002, Michelle Goodman conducted a survey in Florida to help determine the need for a Hospitality Management program at the post-secondary educational level. Goodman received a response rate of 62% from 100 mailed surveys to potential employers of graduates of a Hospitality Management program. The survey was directed

to personnel who may be responsible for hiring employees, such as owners, managers, and human resource individuals. Likert-scale items were used in the questionnaire that was sent to employers.

Yuan-Chih Lin (2003) conducted a survey of hotels located in U.S. cities to try to determine the immediate and near future impact of the September 11, 2001 terrorist attacks on the hotel industry. Lin used telephone interviews to conduct the survey and a pilot survey was conducted prior to the main survey. E-mail was used to help schedule appropriate times for telephone interviews. Lin used open-ended questions and qualitative methods for evaluating results.

Brenda Martineau (2002), a Master of Science in Career and Technical education student in 2002 at UW-Stout, conducted a survey of manufacturing employers who had previously hired Chippewa Valley Technical College (CVTC) Electromechanical Technology graduates. The purpose of Martineau's study was to help determine how graduates were adapting to and using learning technologies based on employer perceptions. Martineau initially contacted 42 manufacturing companies and sent surveys to these companies. A response rate of 34%, or 13 useable surveys was received. The survey used was five pages in length and included selection, Likert-scale items, and written comments. Follow-up letters were sent to non-respondent industries. While Martineau's survey did not request information on job openings, the survey examples, cover letter, and follow-up letter examples appear to be representative of similar surveys and provide a good example of the type of survey that may best represent the needs of this researcher's study to determine the need for graduates of specific industrial technology division programs.

University of Wisconsin market research specialists conducted a study in 2001 to try to determine whether traditional mail or e-mail provided the best approach for conducting surveys. The two questions posed by Howes and Mailloux (2001) asked if there was a difference between students who responded via each approach and if an accurate representation of all students was being achieved. Howes and Mailloux surveyed 2,355 seniors graduating from the UW System. The response rate was 28% for paper surveys and 20% for e-mailed or web based surveys. Howes and Mailloux stated that response rates are typically higher for females than males when using paper surveys, 64% as opposed to 36%; but when using e-mail, males responded at higher rates than females, 55% versus 45%. The researchers concluded that although the web surveys had a lower return, the cost savings and the more equitable gender response rate could justify their use in some circumstances, such as when reliable e-mail addresses were available, and when the demographics and the sampling frame were understood by the researcher.

Based on a review of industry association and student surveys, this researcher used a survey that included demographic questions and multiples selection items. The surveys were distributed using the United States Postal Service. The researcher queried two male owners of industries that have hired industrial technology program graduates from Wisconsin's technical colleges who stated that e-mail was their preferred method of responding to surveys due to time constraints and efficiency, however, a pilot study revealed problems with attaining e-mail addresses and response rates.

Summary

Manufacturing is an important sector of Wisconsin's economy, contributing to economic growth and accounting for nearly one-fifth of the state's employment. This sector has experienced a decline in employment as the result of many factors, one of which is increased productivity. To maintain productivity and remain competitive with other states and globally, manufacturers need a more highly skilled labor force than in the past.

The Wisconsin Technical College System has faced budget cuts and constraints as the state of Wisconsin attempts to rectify a budget deficit. Due to budget constraints, the Wisconsin technical colleges are concerned with meeting the needs of employers, yet they must decrease staff, discontinue programs, or suspend programs with low enrollments. Enrollments in vocational and technical colleges tend to follow industry trends and graduation rates have declined in some industrial technology programs. Manufacturers rely on these programs to educate future and incumbent workers. Students enrolled in Wisconsin's technical college industrial technology programs learn the fundamental skills that industries need.

Industrial employers in Wisconsin may be faced with a skilled worker shortage in the future and there is current evidence that skilled worker shortages are being experienced by some employers around the state. The current number of graduates for some of the industrial technology programs is considerably less than the state of Wisconsin's projected need for workers in occupations graduates would potentially enter. Comparisons between the projected need for specific occupations related to industrial technologies graduates and the number of graduates show some large deficiencies. While

the industrial technologies programs are not the only means for training individuals for the workforce, manufacturers state they have a need for more skilled workers and technical and vocational colleges have been a primary source of workers in the United States. Wisconsin is projecting a need for more than 600 electricians and persons with electronics skills annually, but Wisconsin's technical colleges graduated just over 200 persons in 2003. The projected need for machinists, tool and die makers and CNC programmers/operators each year in Wisconsin exceeds 900 persons; while there were less than 300 graduates of machine tool related programs in Wisconsin's technical colleges in 2003. Graduates of welding related programs in the technical colleges in 2003 was just over 200 persons and Wisconsin's projected need is for just under 600 per year through 2010. The only program examined that does not have a large deficit was in the mechanical design area. The projected annual need for drafters and designers is approximately 140 persons and Wisconsin's technical college districts graduated 131 persons in 2003.

Due to economic fluctuations, global competition, and conflicting reports regarding employment needs of manufacturers and other sectors of the economy, it is unknown to what extent the projections of the Department of Workforce Development, demographers, and economists coincide with the perceived need for employees by Wisconsin's industrial employers.

CHAPTER THREE

Methodology

Introduction

The purpose of this study was to determine the extent to which industrial employers in each of the 16 Wisconsin Technical College districts would need graduates of electronics, mechanical design, machine tool, and welding related programs through the year 2010 in Wisconsin. This chapter will describe how the survey sample was selected, give a description of the sample, and explain the survey instrument. Additionally, data collection methods and data analysis procedures will be described and methodological limitations will be discussed.

Description of Research Design

A descriptive, or normative, research design was used because it "looks with intense accuracy at the phenomena of the moment and then describes precisely what the researcher sees...attempts to clarify the nature of a given situation" (Leedy, 1993, p. 185). The normative survey method allows the researcher to "draw conclusions from one transitory collection of data and extrapolate what is likely to happen again under similar circumstances" (Leedy, 1993, p. 185). This research design provides an in-depth examination and understanding of the problems and accurate descriptions of current conditions.

The survey was designed to determine the current perceptions of industrial employers for the future need of graduates of four specific industrial technology programs in 16 Wisconsin technical college districts. Employers were asked to respond to

survey questions that included demographics, the size of their company, the type of employees needed, their perception of their need for graduates in the next one year period and through the year 2010, to what extent they currently have difficulty finding qualified workers, and their perception of the factors affecting hiring practices at their company.

Selection and Description of Participants

There were approximately 12,014 manufacturers in Wisconsin in 2004 with one or more employees (Harris Infosource, 2003). These manufacturers produce a variety of products, but not all of them hire graduates from the programs being studied. Using the SIC classification system of employers, the employers most likely to hire graduates of the industrial technology programs being studied are those in the following SIC classifications:

- 20-Food and kindred products
- 26-Paper and allied products
- 33-Primary metal industries
- 34-Fabricated metal products, excluding machinery & transportation equipment
- 35-Machinery, except electrical
- 36-Electrical & electronic machinery, equipment, supplies
- 37-Transportation equipment
- 38-Measuring, analyzing, controlling instruments
- 72-Miscellaneous repair services (welding)

The estimated population of manufacturers in Wisconsin with those SIC codes as

their primary manufacturing category was 5,909. The sample size recommended for a population of 6,000 is 361 with an adjusted size allowing for a 70 percent return rate of 516 (Krejcie & Morgan, 1970). However, surveys of manufacturers tend to result in very low response rates. Recent studies of manufacturers conducted by the National Association of Manufacturer's and the Wisconsin Technical College System have resulted in response rates of less than 15%. The cost of printing, paper, supplies, and postage had to be considered for this study, so a target sample size of 1,600 was selected with the hope of achieving a 20 to 25% survey return rate. Two methods of sample selection were used.

Wisconsin's 16 technical college districts vary in size and the distribution of industrial employers who would potentially hire graduates of industrial technology programs. To obtain a sample of the population of industrial employers in each district, graduate follow-up reports or lists of employers who hired graduates were obtained from each of the 16 technical college districts for the most recent previous five year period. In most districts, data from the years 1999 through 2003 were obtained. All 16 technical college districts conduct graduate follow-up surveys each year to try to determine the percentage of graduates who obtain employment related to their training and where they are employed. The graduate follow-up reports list the number of program graduates and the names and cities of the employers who hired graduates. These reports only include data from graduates that have completed and returned the surveys sent by the technical college districts. The 2004 Graduate Follow Up response rate was 73% (Wisconsin Technical College System, 2005). Graduate follow-up reports were also of value in selecting survey recipients because the data could help determine the type of companies

that hire graduates of Electronics, Mechanical Design, Machine Tool and Welding programs. The entire population of employers that hired graduates of these programs in a five year period was used in the study because it was unknown what the population or demographics was of employers in each district. This type of sample selection is known as a non-probability sampling and is appropriate to use when the population may be difficult to identify (Fink, 2003b). The researcher believed that reasonably fair representation could be established by using employers that had previously hired graduates in each district. Based on the SIC descriptions and size of the companies in the 2004 Wisconsin Manufacturers Directory that had previously hired graduates, comparisons were made when selecting additional survey recipients.

Graduate data from electronics-related programs, machine tool related programs, mechanical design programs, and welding related programs were compiled from all technical college districts and the companies who hired graduates was recorded along with the cities where the companies were located. Companies that were not in Wisconsin were eliminated from the sample. Internet searches were conducted to determine the current address of the companies and to verify the existence of the company. The 2004 Wisconsin Manufacturers Directory (Harris Infosource, 2003) was also referenced to determine whether companies were still in business and to obtain address information that could not be obtained through the Internet. This resulted in 1,118 companies that have hired graduates of the programs investigated in this study.

While manufacturers are the primary employers of graduates of the programs in this study, they are not the only employment sector that has hired program graduates. To include all types of employers that hired graduates, all 1,118 companies that were

determined to still be in business and who had hired graduates within the most recent five year period in which data was available from the programs being studied were included in this study. In most of the 16 Wisconsin technical college districts, but not all of them, programs from all four career areas studied were offered. An average of 25 survey participants was desired for each program area in each district for a total average sample of 100 in each district. This is where the target sample size of 1,600 was obtained. However, there were an unknown number of potential employers in each district and each district had an uneven distribution of employers in program areas and by size when compared to other districts. Cities were listed alphabetically in the 2004 Wisconsin Manufacturers Directory, and when selecting the additional 501 survey recipients from this directory it was assumed that the number of companies would be relatively representative of each district based on the population of manufacturers in each city. For example, Appleton was in the Fox Valley Technical College (FVTC) district and because of the large number of manufacturers in Appleton (and in FVTC) the systematical counting of companies resulted in a larger sample from Appleton than smaller cities. Each city in the directory had an equal chance of being selected; however, the districts with smaller populations had fewer cities with manufacturing companies and fewer survey recipients were selected. The Nicolet Area Technical College district had very few manufacturing companies that would potentially hire graduates of the four programs studied and the small sample size tends to reflect the lower number of representative companies.

To determine the additional companies that would make up the desired sample size, systematic selection was used. In the systematic sampling method, "every nth

person is selected" (Patten, 2001, p76). When selecting a random starting point and using an alphabetical list, this method of systematic sampling may be as unbiased as a simple random sample (Patten, 2001). Starting with the first city in the 2004 Wisconsin Manufacturers Directory (Harris Infosource, 2003), a company was randomly selected as the starting point. From this company forward, every 22nd company was evaluated for inclusion in the survey. Based on the company description and SIC classification, if the company was similar to companies that had previously hired program graduates and had more than one employee, it was selected. If the company was not similar, the next closest company in the directory that met the selection criteria was selected. This method of selection resulted in the selection of 501 additional companies that were representative of the concentration of employers within a given area of the state of Wisconsin. The total sample size was 1,619.

Instrumentation

The method of data collection used was a survey. A cover letter (see Appendix A) was sent with the survey describing the purpose of the study, requesting recipient participation, and providing contact information. The survey instrument was designed to determine the perception of employment needs of industrial employers for graduates of electronics, mechanical design, machine tool, and welding related programs in each of the 16 Wisconsin technical college districts through the year 2010. The length of the survey, when printed, was five pages. The first page included a description of the study, the potential risks and benefits of participation in the survey, a confidentiality statement, the informed consent statement, and contact information.

The survey used for this study was paper based and delivered via US postal service. There were no instruments to meet the specific needs of this study, so an original survey was designed. Because the instrument was designed for this study by the researcher, there were no measures of validity or reliability; however, the survey was reviewed by the research committee and a pilot survey (see next section) was conducted prior to finalization. A copy of the survey can be found is Appendix B.

This study sought to determine the extent to which employers in each Wisconsin technical college district needed employees of four programs. The survey was composed of questions and selection categories requesting the zip code and the size of the company, whether the employer had hired technical college graduates in the past and the type of program graduates hired by their company, when they had hired graduates, how much difficulty they have had finding employees, their perception of the factors affecting hiring employees at their company, and their need for employees in the future.

The first item of the survey requested the zip code to determine the city that respondents' companies were located in. The city could be determined from the zip code and was then used to determine the district that the company was in. The district in which each respondent's company was located had to be known to segregate data for that district. Data for individual districts and the need for specific program graduates could be then be cross-tabulated and analyzed.

The size of each respondent's company, by employee number, was requested as the second survey item to determine what size company's were most likely to hire graduates of the four programs studied. Although the majority of the sample (69%) was selected from employers that had previously hired graduates of the technical colleges, the

third survey item was included to determine how many companies of the total sample had hired graduates of Wisconsin's technical colleges in the past.

The fourth survey item was included to determine what program areas studied that survey respondents had or would potentially hire graduates from and allowed respondents to select all career areas that applied to their company. This survey item was also used to describe the various job titles that each program area could include to help respondents determine if their company hired employees with those job titles when the general program area may not have been known.

The fifth survey item asked respondents how long ago they had hired graduates of the programs studied and gave four time periods from which they could choose. Respondents were encouraged to select all that applied to their company. This item was added to help the researcher determine hiring trends for graduates of the technical colleges in the past.

Item six of the survey was included to determine in which programs (career areas) respondents had difficulty finding qualified workers in the past year and could be answered with a yes or no check box. Respondents were encouraged to select all career areas that applied to them. To help determine the reasons that respondents believed were responsible for difficulty finding qualified employees, survey item seven asked respondents that selected any "yes" response for survey item six to select any applicable options in item seven. The options for item seven were created to help determine if there were applicants for positions, if there was a skills shortage, whether applicants had the required degree or credentialing for open positions, and if they were required to have more work experience for positions they were applying for. The researcher was also

interested in finding out how many employers had difficulty finding workers due to employee resistance to working some shifts due to recent media reports about generational differences related to work ethic and student reluctance to take jobs that were in the evenings, weekends, or nights. There was also the need to determine whether the technical college graduates that applied for positions had the right level of technical skills required for entry level positions, so this option was included. To determine if there were other factors that were not included as selection options, an "other" option was included along with a line on which respondents could write in other reasons for difficulty finding qualified workers.

Because respondents often hired more than one type of program graduate, item eight asked them which career area they had the most difficulty finding employees if they had selected any "yes" box in survey item six.

Whether respondents had difficulty finding qualified employees in the past year or not, the researcher sought to find out what factors had affected respondents' hiring practices in the past year. Survey item nine included seven options for selection and respondents were encouraged to select all that applied to them. Manufacturing employment had declined and layoffs were well publicized between 2001 and 2004, so the first option asked if the slowdown of the economy was a factor affecting hiring practices. Lack of orders or work was the second selection and was included for the same reasons that the first option was included. From the review of literature, technology changes were requiring fewer employees, so this was included as a selection option. To determine whether more respondents were opting for in-house training of incumbent workers as opposed to hiring new employees, a selection option for this was included.

The researcher wished to determine whether a lack of funds was a problem for respondents, whether to upgrade, to remain competitive, or for other reasons, so this was an option that respondents could select. Job classifications have changed as the result of technology and competition, to determine how much this was a factor in hiring, respondents had the option of selecting this for survey item nine. Additionally, to determine if there were factors that had not been included as selection options, an "other" option was included with a line on which respondents could record other factors that had affected their hiring practices other than those already listed.

To determine the short term needs of Wisconsin's industrial employers for employees, survey items 10 through 12 were included. Survey item 10 sought to determine how many respondents planned to add employees due to the growth of their companies in 2005. This was asked to help determine the perception of respondents to the projected rebound of manufacturing employment. The Wisconsin Department of Workforce Development publishes projections that are based on employee replacements and growth and this survey item sought to determine employee need due to growth. Survey item 11 sought to determine new employee need due to attrition, such as retirements and replacing workers. Survey item 12 was needed to determine the minimum number of employees needed by respondents for 2005. The researcher believed that respondents would have a better idea of employee needs for the short term (2005) than for an extended period of time. The exact number of employees may not have been know by respondents and to increase the response rate for each year so that respondents would not become frustrated by having to commit to a single employee number, selection ranges were used rather than requesting exact numbers.

Survey item 13 was used to determine the long term employment needs of survey respondents. Each year, 2006 through 2010, was included with individual selection categories for each of the four career areas with three ranges of employee numbers to select from, a selection box for respondents that did not know how many employees or if they would need employees, and a selection box for those respondents that were certain that they would not need employees for that year.

Pilot Study

There are many reasons pilot surveys are conducted prior to the major survey. Pilot surveys test the survey instrument, the distribution method, the sample, costs and other aspects of the methodology of the study on a smaller scale than the major survey. The participants of the pilot survey should be similar to those who will be selected for the main survey and the results can be used to help the researcher determine the revisions that need to be made for the main survey (Fink, 2003a).

The pilot survey was conducted in November 2004 to help determine the best method of distributing the survey to employers and so that modifications could be made to the survey instrument if indicated. The pilot survey was sent to eight employers in each of the four WTCS districts with populations of 400,000 or more. The four largest districts were the Madison Area Technical College, Milwaukee Area Technical College, Gateway Technical College, and Fox Valley Technical College districts. Eight employers were systematically selected from the largest city in each of the four districts using the 2004 Wisconsin Manufacturer's Directory (Harris Infosource, 2003) for the selection process. These cities were Madison, Milwaukee, Racine, and Appleton.

To help determine the distribution method and follow up processes that would work best for the main research survey, 19 surveys were sent via United States Postal Service and 11 surveys were sent using Internet e-mail addresses. Surveys were addressed to company presidents, managers, or human relations personnel. To determine who responded, so that reminder notices and duplicate surveys would not be sent to companies that had already completed surveys, post cards were included in the survey mailing to be returned separately from the survey.

The response rate for the pilot study surveys mailed via United States Postal Service was 21% (n=4). Of the e-mailed surveys, two were returned as undeliverable, and one employer responded, representing a response rate of 9%.

The pilot study revealed problems with sending surveys via Internet e-mail. Current e-mail addresses were difficult to obtain and if the person contacted no longer worked for the company, the survey was not able to be forwarded to a person who could complete it and return it.

Problems were also encountered with the methods used in the pilot study to mail surveys using the United States Postal Service. The post cards, sent with the survey to avoid reminder notices, but were intended to be returned separately so that companies could remain anonymous, were not necessarily returned. Additionally, some companies returned the post card separately, but others returned them enclosed with the completed survey. The researcher determined that post cards would not be included in the mailing for the main survey, but that reminder cards would be sent separately approximately ten days before the survey return deadline. The second perceived problem was with addressing the surveys to company owners or representatives. Surveys addressed to

specific persons would not be opened and completed if the person the survey was addressed to was no longer employed by the company. The researcher decided that the envelopes the surveys were sent to companies in would not be addressed to specific individuals, but would be addressed only to the company. Based on the results of the pilot study, the researcher determined that the main survey should be distributed via mailing through the United States Postal Service and e-mailing via the Internet should not be used.

The second purpose of the pilot study was to help determine the readability and validity of the survey. Respondents were not told that the survey was a pilot study because the researcher felt that survey recipients would be less likely to take the time to complete the survey. Based on the correct completion of the survey by respondents, no problems with the readability of the survey were detected. The data collected tended to correlate with the information sought to answer the research questions and at the time, there appeared to be no reason to change the design of the survey prior to using it for the main study.

Data Collection Methods

The survey and a cover letter were sent to participants identified from Wisconsin Technical College System graduate follow-up reports and from the 2004 Wisconsin Manufacturers Directory via United States Postal Service mail in the second week of February 2005. Postage paid return envelopes that were addressed to Western Wisconsin Technical College were enclosed in the mailing for the return of the survey. There were 1,619 surveys sent from Western Wisconsin Technical College using bulk

mail with return service requested. Participants were asked to respond by March 11, 2005. After 20 days, reminders were mailed to all survey recipients except those that had responded who had included their company names or addresses and those companies that the United States Postal Service returned unopened survey envelopes from because they were no longer in business or the surveys could not be delivered to them. Data collection was completed by March 31, 2005. The reminder card can be seen in Appendix C.

Of the 1,619 surveys sent, two were found to be addressed to duplicate addresses, 18 were returned as not applicable to the recipient company, and 44 were returned as not deliverable. This resulted in 1,555 surveys being sent to Wisconsin employers who would potentially hire graduates of the programs studied. There were 397 surveys returned by March 31, 2005 for a return rate of 25.5%. However, six respondents chose not to participate in the study, which resulted in 391 valid surveys for this study, or a return rate of 25.1%. The return rate varied by district as shown in Table 1. Response rates varied from 14% in the Nicolet district to 35% in the Northcentral Technical College district. Fourteen districts had return rates of 20% or greater with six of those districts having response rates higher than 25%.

Table 1.

Survey Distribution and Response by Wisconsin Technical College District

District	Sent n	Response n	Return %
Blackhawk	42	13	31
Chippewa Valley	73	25	34
Fox Valley	148	34	23
Gateway	96	22	23
Lakeshore	47	11	23
Madison Area	154	45	29
Mid State	40	9	22.5
Milwaukee Area	207	41	20
Moraine Park	133	25	19
Nicolet	14	2	14
Northcentral	101	35	35
Northeast Wisconsin	134	32	24
Southwest Wisconsin	37	9	24
Waukesha	124	27	22
Western Wisconsin	93	27	29
Wisconsin Indianhead	106	30	28
Unknown	--	4	--
Total	1,549	391	

Table 2 shows the estimated population of SIC employers in each Wisconsin Technical College District (Harris Infosource, 2003), the number of surveys sent to each district, the estimated percent of surveys sent to SIC employers in each district, and the estimated representation of the response rate for SIC employers in each district. The response percent of representation of SIC employers ranged from 3.6% in the Waukesha County Technical College district to 16.8% in the Northcentral Technical College district. Comparatively, the survey sample sent to the Waukesha district was the lowest of the districts at 16.4%, and the number of surveys sent, as a percentage of SIC population, was the second highest in the Northcentral Technical College district.

Table 2.

District Estimated SIC Employer Population Size and Survey Percentages

District	Est. SIC Employers	Sent n	% sent of Est. SIC	% survey response of Est. SIC
Blackhawk	173	42	24.3	7.5
Chippewa Valley	215	73	34.0	11.6
Fox Valley	514	148	28.8	6.6
Gateway	522	96	18.4	4.2
Lakeshore	251	47	18.7	4.3
Madison Area	583	154	26.4	7.7
Mid-State	152	40	26.3	5.9
Milwaukee Area	989	207	20.9	4.1
Moraine Park	495	133	26.9	5.1
Nicolet Area	53	14	26.4	3.8
Northcentral	208	101	48.6	16.8
Northeast Wisconsin	431	134	31.1	7.4
Southwest Wisconsin	98	37	37.8	9.2
Waukesha	754	124	16.4	3.6
Western Wisconsin	165	93	56.4	16.4
Wisconsin Indianhead	306	106	34.6	9.8
Total	5,909	1,549		

Data Analysis Procedures

Data collected was analyzed using Statistical Package for the Social Sciences (SPSS®) version 13.0 computerized statistics software. Descriptive statistical analysis was used to analyze data in this study. Frequencies and percentages were calculated for statewide demographic data and employment projections. Cross-tabulation was used to segregate each of the four programs and the 16 technical college districts for specific data frequencies and percentages.

Limitation of Method, Sample, and Procedures

Participants were primarily selected from those companies which have already hired graduates and it may be unsatisfactory to generalize the results to the entire population of industrial employers in the state of Wisconsin. There may be many new companies that should have been included which would allow the sample to be more generalizable. Although the instrument used was reviewed by the committee, it has no documented measures of validity or reliability. Participants are industrial employers, who typically have a low response rate to surveys. The sample size was increased to yield a sufficient response for statistically significant results; however, limited response rates for some or all districts and/or areas of inquiry may prevent valid conclusions.

Summary

This chapter described the purpose of the study relevant to the research design, the survey sample selection process and a description of the participants, the rationale for

the instrumentation and survey items used to conduct the survey, data collection and analysis procedures utilized, and limitations related to the procedures.

CHAPTER FOUR

Analysis and Discussion

Introduction

The purpose of this study was to determine the extent to which industrial employers in each of the 16 Wisconsin technical college districts need graduates of electronics, mechanical design, machine tool, and welding related programs through the year 2010 in Wisconsin. The study sought to determine whether employers were having difficulty finding employees in the programs being studied and if so, their perception of the reasons for the difficulty and the extent to which they were having difficulty finding employees. The results of the study could be used by the Wisconsin technical college districts to help evaluate the viability of programs, marketing needs, and program planning through the year 2010. Additionally, the results of the study could be used by career counselors when advising students and prospective students on career choices.

Surveys were sent to manufacturing employers in Wisconsin who had previously hired graduates and who would potentially hire graduates of the electronics, mechanical design, machine tool, and welding related programs being studied. Respondents were asked several types of questions to determine their geographic location, company size, which programs their company had hired or would potentially hire graduates in, whether they were currently having difficulty finding qualified employees to fill positions in the four programs studied, and their employee needs for the years 2005 through 2010. The surveys were sent in February 2005 and recipients were asked to respond by March 10, 2005. Data collection was completed by March 31, 2005. Descriptive statistics were used for data analysis using SPSS® software.

This chapter will describe the demographics of the survey respondents, analyze each survey item, and quantifiably answer all research questions based on cross tabulations and analysis of the survey items. A summary will conclude this chapter.

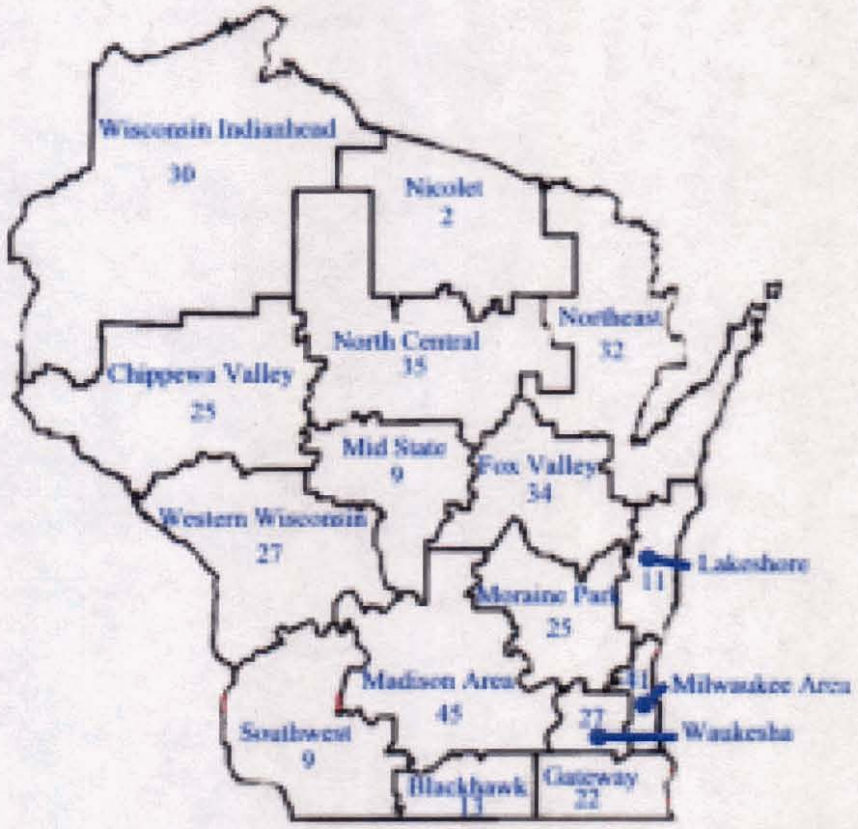
Demographics

The survey was sent to 1,549 employers in the State of Wisconsin that have previously hired graduates, or would potentially hire graduates, of Electronics, Mechanical Design, Machine Tool, and Welding related programs from Wisconsin's 16 technical colleges. There were 391 respondents to the survey and all 16 technical college districts were represented in the study. This resulted in a response rate of 25.1%.

The first four survey items were designed to determine demographic information about respondents. The district representation was determined by requesting the zip code of the respondent's company location. Figure 1 shows the district locations in the state of Wisconsin and the number of respondents from each district. There were four respondents for which districts could not be determined. The size of the companies that respondents represented varied from less than 10 to greater than 501 employees. The greatest response with regards to size was 11 to 50 employees, with 33.2% of the survey representation from companies of this size. The number of respondents that would hire graduates of each type of program studied was 163 for Electronics programs, 218 for Mechanical Design programs, 267 for Machine Tool programs, and 178 for Welding programs. The majority of respondents, 88.5%, had hired graduates of Wisconsin's technical colleges in the past.

Figure 1.

Wisconsin Technical College District Survey Representation



Note: Image of Wisconsin Technical College Districts modified from Wisconsin Technical College System District Map. (http://www.witechcolleges.com/map.htm)

Item Analysis

This section will describe and discuss the results of each question or item on the survey. The results, as frequencies and percentages, will be displayed in tables for the statewide results. Cross-tabulated data for each of the 16 Wisconsin Technical College System districts will be discussed and displayed in tables for several survey items along with the results and discussion of statewide data.

Item one of the survey requested the zip code of the respondent's company location and was necessary to determine the Wisconsin Technical College System district in which the company was located. Of the 1,549 valid surveys sent, there were 391 respondents. Four respondents did not specify a zip code and could not be placed in a district; however, the surveys were still used for analysis of statewide results. All sixteen Wisconsin Technical College Districts were represented in this study. Table 3 shows the number of survey sent to each district, the percent that each district was represented based on the number of surveys sent, the response rate was of the total, and the percent return rate for each district. The return rate for the districts ranged from 14.3% in the Nicolet district to 34.7% in the Northcentral Technical College district. The district with the largest number of respondents was the Madison Area Technical College district with 45 (29.2%) respondents.

Table 3.

Respondent Representation by District

	Surveys sent		Surveys returned	
District	n	%	n	%
Blackhawk	42	3.3	13	31.0
Chippewa Valley	73	6.4	25	34.2
Fox Valley	148	8.7	34	23.0
Gateway	96	5.6	22	22.9
Lakeshore	47	2.8	11	23.4
Madison Area	154	11.5	45	29.2
Midstate	40	2.3	9	22.5
Milwaukee	207	10.5	41	19.8
Moraine Park	133	6.4	25	18.8
Nicolet	14	.5	2	14.3
Northcentral	101	9.0	35	34.7
Northeast	134	8.2	32	23.9
Southwest	37	2.3	9	24.3
Waukesha	124	6.9	27	21.8
Western Wisconsin	93	6.9	27	29.0
Wisconsin Indianhead	106	7.7	30	28.3
District Unknown	--	1.0	4	0.26

Total	1,549	100	391

Item two of the survey asked: "How many employees are employed by your company?" This question was followed by six choices that gave a range for respondents to select from. The results of survey item two are shown in Table 4, which shows the company employee size choices that respondents had, the number of responses to each choice, and the percent of respondents that represented companies of each size. The most frequent response was from companies employing 11 to 50 employees with 33.2% of respondent companies in this size category. Large companies employing 501 or more employees accounted for 11.3% of the respondents.

Table 4.

Number of Employees Employed by Company Responding-State

Company size	Number	%
10 or less employees	41	10.5
11 to 50 employees	130	33.2
51 to 100 employees	69	17.6
101 to 250 employees	66	16.9
251 to 500 employees	40	10.2
501 or more employees	44	11.3
Not answered	1	.3
Total	391	100

The third item on the survey asked, "Have you hired graduates of Wisconsin's technical colleges in the past?"

There were 390 responses to this item with 88.5% of respondents indicating that they had previously hired technical college graduates. Table 5 shows the number and percentages of the responses and non-respondents of survey participants.

Table 5.

Hired Wisconsin Technical College Graduates in the Past—State Data

Response	Number	%
Yes	346	88.5
No	44	11.3
No Response	1	.3

Table 6 shows the percentages and numbers of responses for each district of those respondents that have and have not hired graduates of Wisconsin technical colleges in the past. In 13 of the 16 districts, more than 75% of respondents had hired graduates in the in the past.

Table 6.

Hired Wisconsin Technical College Graduates in the Past—By District

	Yes		No	
District	%	n	%	n
Blackhawk	92.3	12	7.7	1
Chippewa Valley	96.0	24	4.0	1
Fox Valley	91.2	31	8.8	3
Gateway	77.3	17	22.7	5
Lakeshore	72.7	8	27.3	3
Madison Area	91.1	41	8.9	4
Midstate	100.0	9	0	0
Milwaukee	80.5	33	19.5	8
Moraine Park	84.0	21	16.0	4
Nicolet	50.0	1	50.0	1
Northcentral	94.3	11	5.7	2
Northeast	96.9	31	3.1	1
Southwest	100.0	9	0	0
Waukesha	74.1	20	25.9	7
Western Wisconsin	88.9	24	11.1	3
Wisconsin Indianhead	93.3	28	3.3	1
Total		320		44

Item four of the survey asked, "Have you in the past, or would you potentially hire graduates of the following program areas?" This question was followed by selection categories for Electronics related programs, Machine Tool related programs, the Mechanical Design technology program, and Welding related programs. Respondents were asked to select all categories that applied to their company. The highest response rate was for Machine Tool related programs with 68.3% of respondents hiring graduates in this program area. There was 55.8% of respondents who would hire Mechanical Design program graduates; 45.5% who would hire Welding program graduates; and 41.7% who would hire Electronics related program graduates. This survey item was used to determine whether respondents would be included or excluded in the study. Those respondents who did not select any of the program categories were determined to be not relevant to the study. Table 7 shows the number of responses and percentages of respondents that hire or would potentially hire graduates from each of the four Wisconsin Technical College System programs studied.

Table 7.

Employers Who Have or Would Potentially Hire Graduates of Specific Programs

Program	Number	%
Electronics	163	41.7
Mechanical Design	218	55.8
Machine Tool	267	68.3
Welding	178	45.5

The fifth item of the survey asked, "If you have hired graduates of the programs listed in question #4 in the past, approximately how long ago did you hire graduates?" This survey item was included to determine how many respondents had hired graduates within the past year, and in previous years. Respondents were given four choices and asked to select all that applied. Table 8 shows the response choices and the number and percent of respondents that selected each response. Several respondents wrote comments next to the choices stating that they were unsure. The most frequent response was "2 to 5 years ago" with 53.7% of respondents selecting this choice. There were 36.1% of respondents stating that they have hired graduates within the past year.

Table 8.

How Long Ago Respondents Hired Graduates of the WTCS

	Number	%
Within the past year	141	36.1
2 to 5 years ago	210	53.7
6 to 10 years ago	96	24.6
More than 11 years ago	44	11.3

Item six of the survey was designed to determine the extent to which employers have had difficulty finding workers in the career areas studied. The item asked, "In the past year, has your company had difficulty finding qualified workers to fill positions in any of the following career areas?" This item was followed by "yes" and "no" choices for each program area and respondents were asked to answer all career areas that applied to

their company. Results were cross-tabulated for each career area to represent the percentage of responses only for those companies who would hire in those career areas and not for all 391 survey respondents. Table 9 shows the percent of "yes" responses and the number of responses in each career area. More than half of respondents from three of the career areas stated that they have had difficulty finding employees in the past year. The career area that employees have the most difficulty finding qualified workers in is the Machine Tool related area with 61.8% of respondents stating they have had difficulty finding workers in the past year. The next highest percentage of respondents reporting difficulty finding qualified workers was in the Welding related area, with 57.3% of respondents having difficulty finding employees in the past year. There were 55.8% of respondents who hire Electronics related program graduates and 41.7% of respondents who hire Mechanical Design program graduates stating they had difficulty finding workers in the past year.

Table 9.

Difficulty Finding Qualified Workers—Past Year—State Data

		Number	
Program	%	Yes	Companies Hiring in Program
Electronics	55.8	91	163
Mechanical Design	41.7	91	218
Machine Tool	61.8	165	267
Welding	57.3	102	178

To help determine the reasons that respondents had difficulty finding qualified workers if they answered "yes" to item six, they were asked to respond to item seven. Item seven asked, "What do you believe are the reasons you have had difficulty finding qualified workers?" This was followed by seven choices and respondents could select as many as they believed applicable to their situation. These choices are shown in Table 10 with the percent and number of respondents that selected each choice.

Respondents cited a lack of skills for the career position as the greatest reason they have difficulty finding qualified workers. Approximately half of all respondents (n=198) stated that applicants lacked the skills required for the position. More work experience was required for positions by 30.4% of the respondents and nearly 20% of respondents stated that applicants for positions did not want to work the shift or hours that the position required. Only 4.3% of respondents stated that their hiring practices had been affected by the need for higher levels of technical skills than those that technical college graduate applicants possess. There were approximately 20 comments written by respondents for the "Other" selection choice. These can be viewed in Appendix D, Table D2. Responses to survey item seven for each individual technical college district are shown in Appendix Table D1.

Table 10.

Reasons for Difficulty Finding Qualified Worker-State Data

Reason	%	Number
Applicants did not have the skills required for the position	50.6	198
Applicants did not have the prior work experience required for the position	30.4	119
Applicants did not have degree or credentialing required for the position	21.5	84
Applicants did not want to work the shift or hours required for the position	19.2	75
No applicants for position	18.2	71
Other	6.6	26
Technology changes that require employees with higher levels of skills than those of technical college graduates who have applied	4.3	17

The eighth item of the survey was designed to determine in which program area respondents were having the most difficulty finding technical college graduates if they had responded "yes" to item six of the survey. While respondents could select more than

one career area in item six, item eight was included in the survey to help determine the one career area employers had the most difficulty finding workers by considering respondents often hire from more than one career or program area. Item eight asked, "In which job area do you find it the most difficult to find technical college graduates to fill positions?" This was followed by selection choices for each of the four program areas included in the study.

As shown in Table 11, respondents had the most difficulty finding technical college graduates to fill positions in the Machine Tool related area with 48.7% selecting this program area. The Welding related and Electronics related program areas each had approximately 37% of respondents citing these programs as the areas where they had the most difficulty finding technical college graduates. In the Mechanical Design program area, 16.5% of respondents who hire from this program area stated that this was the career area they had the most difficulty finding graduates to fill positions. The results of survey item eight were cross-tabulated with survey item four to prevent bias in favor of the career areas with the highest respondent representation. Table 11 contains the cross-tabulated data.

Table 11.

Job Area Most Difficult to Find Technical College Graduate Workers

Career Area	%	n	Companies Hiring in Career Area
Electronics	37.4	61	163
Mechanical Design	16.5	36	218
Machine Tool	48.7	130	267
Welding	37.1	66	178

Item nine of the survey sought to discover factors other than those asked in item seven which have affected the hiring practices of companies in the past year. This item asked, "What other factors have affected hiring practices of your company in the past year?" There were seven choices that respondents could select and they had the option of selecting as many as applied to their situation.

Table 12 shows the seven choices for survey item nine and the percentages and number of respondents that selected each choice. The most frequently selected choice was "Slowdown of economy" with 36.8% of respondents citing this as a factor affecting their hiring practices in the past year. Approximately 20% of the respondents stated that they required more in-house training rather than training from external sources. There were ten respondents who wrote comments stating that, contrary to the economic slowdown responses, their business was up dramatically. Responses by district and a complete list of responses in the "Other" selection category are included in Appendix D,

Table D3. Responses for each individual technical college district are shown in Appendix Table D4.

Table 12.

Reasons for Difficulty Finding Qualified Workers

Reason	%	Number
Slowdown of economy	36.8	144
Lack of orders or work	32.5	127
More in-house training is required rather than training from external sources	20.5	80
Technology changes that require fewer employees	16.1	63
Other	14.1	55
Lack of funds	11.0	43
Changes in job classifications (reconfiguration)	6.9	27

Item 10 of the survey asked, "Do you anticipate hiring new employees as the result of company growth in the next year (through 2005)?"

In Wisconsin, 78.0% (n=305) of respondents stated that their companies plan to hire new employees due to growth in 2005. Table 13 shows the percentage and number of respondents stating that they planned to hire in 2005 due to growth. The percentages varied by district, but ranged from 68.8% to 100% in all but one of the sixteen technical college districts in Wisconsin. The Wisconsin technical college districts of Chippewa Valley and Lakeshore Technical College reported the highest expected hiring rate for 2005 with more than 90% of respondents in those districts expecting to hire new employees due to company growth. While responses in the Southwest Wisconsin Technical College district were the lowest of all 16 technical college districts, one-third of respondents were still expected to hire in 2005 due to company growth.

Table 13.

Plan to hire new employees in 2005 due to company growth - By District

District	%	Number
Blackhawk	69.2	9
Chippewa Valley	92.0	23
Fox Valley	85.3	29
Gateway	81.8	18
Lakeshore	100.0	11
Madison Area	71.1	32
Midstate	77.8	7
Milwaukee Area	85.4	35
Moraine Park	88.0	22
Nicolet	100	2
Northcentral	77.1	27
Northeast	68.8	22
Southwest	33.3	3
Waukesha	81.5	22
Western Wisconsin	70.4	19
Wisconsin Indianhead	70.0	21

Item 11 of the survey was designed to help determine the percentage of companies that planned to hire in the next year due to reasons other than growth, such as retirements or replacing employees. Item 11 asked, "Do you anticipate replacing employees in the next year due to retirements or for other reasons unrelated to company growth?"

Statewide, 52.5% of respondents indicated that they planned to hire for reasons other than growth in the next year. Table 14 shows the percentages of respondents who answered "yes" to item 11 for each of the Wisconsin technical college districts. There were 13 of the 16 districts in which 50% or more of the respondents stated that they planned to hire for reasons other than growth. The district of Lakeshore Technical College had the highest response rate with 63.6% of respondents expecting to hire employees in 2005 due to reasons such as retirements and replacing workers. Southwest Wisconsin (33.3%) and Chippewa Valley (36.0%) Technical College districts had the lowest percentages of respondents that stated that they planned to hire for reasons other than growth.

Table 14.

Plan to hire new employees in 2005 for reasons other than growth - By District

District	%	Number
Blackhawk	61.5	8
Chippewa Valley	36.0	9
Fox Valley	61.8	21
Gateway	59.1	13
Lakeshore	63.6	7
Madison Area	55.6	25
Midstate	55.6	5
Milwaukee Area	61.0	25
Moraine Park	52.0	13
Nicolet	50.0	1
Northcentral	42.9	15
Northeast	40.6	13
Southwest	33.3	3
Waukesha	59.3	16
Western Wisconsin	51.9	14
Wisconsin Indianhead	53.3	16

Survey item 12 was designed to help determine the minimum number of employees that employers in Wisconsin planned to hire in the year 2005 in each of the four program areas being studied. Item 12 asked, "If you anticipate hiring new employees or replacing employees in the next year (2005), please estimate the number of new employees needed for each of the following applicable career areas: Electronics related; Mechanical design related; Machine tool related; Welding related." Following each career area were four selection choices that allowed respondents to select from a range of employee numbers. The selection choices were: "1 to 3 employees; 4 to 6 employees; 7 or more employees;" or "Number unknown." Presenting respondents with a range allowed them to estimate numbers rather than requiring specific numbers, which may not have been known.

Table 15 shows the minimum number of employees needed for each program area and the number of respondent companies stating they plan to hire new or replacement employees in 2005. Minimum employee numbers were calculated by multiplying the number of respondents for each selection range by the lowest number in each range. The products of each of the selection ranges were summed to achieve the minimum number of employees needed by respondents.

Machine Tool related careers had the greatest number of employees needed, with 195 respondents stating they would need at least 444 new or replacement employees in 2005. Respondents cited the second largest need for employees in welding careers with a minimum of 322 employees needed in 2005.

Table 15.

Minimum number of new or replacement employees needed in 2005—State Data

	Employees	Respondents Hiring
Career Area	n	n
Electronics	165	105
Mechanical Design	180	126
Machine Tool	444	195
Welding	322	112

To determine the percentage of respondents that would need new or replacement employees in 2005, only those respondents that stated they would hire from each career area was used for the calculations. Table 16 shows the number of respondents that would potentially hire in each career area, the number and percent of respondents that stated they plan to hire in 2005, and the number and percent of respondents that were unsure what the number of new or replacement employees they would need in 2005 would be.

There were 73.0% of respondents that planned to hire employees in the Machine Tool related career areas in 2005. Approximately 64% of respondents planned to hire in each of the Electronics and Welding related career areas. The need for employees in the Mechanical Design related career areas was slightly lower with 60.6% of respondents planning to hire employees in 2005. The lowest level of uncertainty regarding hiring in 2005 was by respondents hiring employees in the Machine Tool related careers.

Table 16.

Number and Percent of Respondents Hiring in 2005—State Data

	Hiring		Unsure		Hiring in Career Area
Career Area	n	%	n	%	n
Electronics	105	64.4	26	16.0	163
Mechanical Design	126	60.6	24	11.0	218
Machine Tool	195	73.0	23	8.6	267
Welding	112	64.7	30	16.9	178

Table 17 shows the responses for survey item 12 cross-tabulated by district and by respondents that hire Electronics related employees. Nine districts have the need for a minimum of 10 employees in 2005 based on the small sample size of the survey respondents in those districts. The sample size was larger in the Madison Area and Northcentral Technical College districts and the minimum number of Electronics related employees needed in those two districts is 19 and 20, respectively.

Table 17.

2005 Electronics Related Employee Estimates by District

	Number		
District	Minimum Openings	Hiring	Unsure
Blackhawk	5	5	--
Chippewa Valley	13	11	3
Fox Valley	14	8	2
Gateway	12	3	1
Lakeshore	7	4	--
Madison Area	19	16	3
Midstate	1	1	2
Milwaukee	15	9	--
Moraine Park	4	4	2
Nicolet	1	1	--
Northcentral	20	8	3
Northeast	14	14	1
Southwest	3	3	1
Waukesha	7	4	1
Western Wisconsin	11	5	5
Wisconsin Indianhead	10	7	1
Total	156	103	25

Table 18 shows the responses for survey item 12 cross-tabulated by district and by respondents that hire Mechanical Design related employees. There were eight districts in which respondents stated the need for a minimum of 10 new Mechanical Design related employees in 2005. The greatest need for new employees was in the Chippewa Valley, Fox Valley, Milwaukee Area, Northcentral, and Northeast Wisconsin Technical College districts with each of those districts needing a minimum of 18 new employees in 2005.

Table 18.

2005 Mechanical Design Related Employee Estimates by District

District	Number		
	Minimum Openings	Hiring	Unsure
Blackhawk	8	5	1
Chippewa Valley	21	9	1
Fox Valley	18	12	2
Gateway	7	7	1
Lakeshore	9	6	--
Madison Area	14	14	6
Midstate	--	--	--
Milwaukee	23	14	2
Moraine Park	9	9	2
Nicolet	1	1	--
Northcentral	30	15	2
Northeast	18	12	1
Southwest	--	--	2
Waukesha	10	7	--
Western Wisconsin	4	4	5
Wisconsin Indianhead	11	8	1
Total	183	123	26

Table 19 shows the responses for survey item 12 cross-tabulated by district and by respondents that hire Machine Tool related employees. Thirteen of the sixteen Wisconsin Technical College districts had the need for more than 10 Machine Tool related employees in 2005. Of those districts, 11 had the need for more 20 employees, with the Fox Valley, Milwaukee Area, Moraine Park, and Wisconsin Indianhead Technical Colleges having the need for more than 40 new Machine Tool related employees.

Table 19.

2005 Machine Tool Related Employee Estimates by District

	Number		
District	Minimum Openings	Hiring	Unsure
Blackhawk	14	8	--
Chippewa Valley	33	12	1
Fox Valley	46	19	1
Gateway	28	16	1
Lakeshore	17	8	--
Madison Area	29	17	3
Midstate	7	4	1
Milwaukee	67	25	1
Moraine Park	41	17	1
Nicolet	1	1	--
Northcentral	38	17	2
Northeast	34	10	3
Southwest	2	2	2
Waukesha	24	12	1
Western Wisconsin	20	11	4
Wisconsin Indianhead	42	15	1
Total	443	194	22

Table 20 shows the responses for survey item 12 cross-tabulated by district and by respondents that hire Welding related employees. There were 13 districts in which a minimum of 10 new Welding related employees were needed in 2005, with the Milwaukee Area and Northeast Wisconsin Technical College districts having the greatest need for new Welding related employees.

Table 20.

2005 Welding Related Employee Estimates by District

	Number		
District	Minimum Openings	District	Minimum Openings
Blackhawk	25	4	--
Chippewa Valley	21	9	1
Fox Valley	21	12	5
Gateway	3	3	1
Lakeshore	10	4	--
Madison Area	22	13	2
Midstate	1	4	--
Milwaukee	33	9	2
Moraine Park	25	7	1
Nicolet	11	2	--
Northcentral	39	9	3
Northeast	46	13	5
Southwest	9	3	2
Waukesha	12	6	1
Western Wisconsin	22	7	4
Wisconsin Indianhead	22	7	2
Total	322	112	29

The thirteenth item on the survey was designed to help determine the minimum number of employees in each of the four career areas being studied that respondents believed they would need in the years 2006 through 2010 in Wisconsin. Item 13 asked, "While the future economic climate is unknown, please give your perception of your company's annual need for employees in each of the following career areas for the years 2006 through 2010. Please answer as best you can." Item 13 presented a table to respondents for the years 2006 through 2010. For each year, the table had columns for the four career areas with five selection choices below each career area. The selection choices given were, "0 employees", "1 to 3 employees", "4 to 6 employees", "7 or more employees", or "Number unknown." Respondents were given a range of employee numbers on the survey rather than requesting specific numbers due to the inability of many companies to predict the exact number of new employees they would need in future years. The objective was to determine industrial employer's perceptions of their needs for employees in the future. To determine the minimum number of employees needed each year and for each program, the lowest number of the selected range was multiplied by the number of employers who selected that range. The sum of the three ranges was used to determine the minimum number of employees needed in each program for the state and for each technical college district.

There were 163 respondents representing companies that hire or would potentially hire employees who have graduated from Electronics related programs. Table 21 shows the minimum number of positions that respondents believe they will need for the years 2006 through 2010 in Electronics related careers, the number and percent of companies hiring for these positions, the number and percent of companies that plan to hire no

employees each year, and the number and percent of respondents who do not know the number of employees that they will need each year. In 2006, nearly 72% of respondents intend to hire at least 189 employees from the electronics related career area. Fifteen percent are not sure if they will be hiring or do not know how many employees they will hire. In subsequent years, the percentage of respondents that state they will hire no employees increases, as does the number of respondents who are unsure. In 2009 and 2010, almost half of the respondents still state that they will be hiring, but more than one-fourth of respondents do not know if they will be hiring or the number of employees that they will need.

Table 21.

Electronics Employees Needed 2006-2010 —State Data

	Positions	Companies		Zero		Unknown	
Year	n	n	%	n	%	n	%
2006	189	142	71.8	15	9.2	25	15.3
2007	129	90	55.2	25	15.3	39	23.9
2008	129	93	57	20	12.3	40	24.5
2009	114	75	46	28	17.1	42	25.8
2010	111	78	47.9	20	12.3	45	27.6
Total	672	478		108		191	

Table 22 shows the minimum number of positions that respondents believe they will need for the years 2006 through 2010 in Mechanical Design related careers, the number and percent of companies hiring for these positions, the number and percent of companies that plan to hire no employees each year, and the number and percent of respondents who do not know the number of employees that they will need each year. There were 218 respondents that stated they hire employees who are in the Mechanical Design career area. Of these respondents, nearly 70% intend to hire a minimum of 209 employees in 2006. Fewer than 10% of respondents were unsure of how many Mechanical Design employees they will need and 12.8% did not plan to hire in 2006. Each year after 2006 shows a decline in the number of respondents that know how many employees they will hire and an increase in the number who are unsure. By 2009 and 2010, approximately 40% of respondents plan to hire and about 20% are unsure. In the years 2007 through 2010, approximately one fifth of respondents do not plan to hire any employees in the mechanical design career area.

Table 22.

Mechanical Design Employees Needed 2006-2010 —State Data

	Positions	Companies		Zero		Unknown	
Year	n	n	%	n	%	n	%
2006	209	152	69.7	28	12.8	20	9.2
2007	153	114	52.3	50	22.9	32	14.7
2008	148	112	51.4	46	21.1	35	16.1
2009	120	90	41.3	50	22.0	42	19.3
2010	113	89	40.8	44	20.2	47	21.6
Total	743	557		218		176	

Table 23 shows the minimum number of positions that respondents believe they will need for the years 2006 through 2010 in Machine Tool related careers, the number and percent of companies hiring for these positions, the number and percent of companies that plan to hire no employees each year, and the number and percent of respondents who do not know the number of employees that they will need each year.

Of the 267 respondents that stated that they hire employees from the machine tool related career areas, 79.8% intend to hire a minimum of 462 employees in 2006. Fewer than nine percent stated they were not hiring in 2006 and about 7% were unsure how many employees they would need or if they would be hiring. While the number of

respondents who plan to hire declines each year, more than half still plan to hire in 2010. In 2007, the percentage of respondents who are unsure of how many employees they will need more than doubles from 7.1% to 15%. By 2010, approximately one-fourth of respondents do not know how many employees they will need. The percentage of respondents that do not plan to hire remains at or below 15% for each year through 2010.

Table 23.

Machine Tool Employees Needed 2006-2010 —State Data

	Positions	Companies		Zero		Unknown	
Year	n	n	%	n	%	n	%
2006	462	213	79.8	23	8.6	19	7.1
2007	352	175	65.5	39	14.6	41	15.4
2008	325	169	63.3	38	14.2	48	18.0
2009	291	144	53.9	40	15.0	60	22.5
2010	268	142	53.2	35	13.1	68	25.5
Total	1,698	701		175		236	

Table 24 shows the minimum number of positions that respondents believe they will need for the years 2006 through 2010 in Welding related careers, the number and percent of companies hiring for these positions, the number and percent of companies

that plan to hire no employees each year, and the number and percent of respondents who do not know the number of employees that they will need each year.

There were 178 respondents that stated that they would hire employees from the welding related program areas. Of these respondents, 70.8% plan to hire at least 360 welding related employees in 2006. Approximately 10% are unsure of how many employees they will need and 10% do not plan to hire any employees in the welding career areas in 2006.

As shown in table 24, the number of respondents who plan to hire declines through 2010 as the number of those who are unsure increases. Forty one percent of respondents plan to hire in 2010 and 23% do not know how many employees they will need or do not know if they will be hiring. Between 2007 and 2010, the number of respondents who do not plan to hire remains fairly steady with a range between 13.5 and 18.5%.

Table 24.

Welding Employees Needed 2006-2010 –State Data

	Positions	Companies		Zero		Unknown	
Year	n	n	%	n	%	n	%
2006	360	126	70.8	17	10.0	19	10.7
2007	261	93	52.2	33	18.5	32	18.0
2008	261	96	53.9	24	13.5	35	19.7
2009	237	84	47.2	25	14.0	37	20.8
2010	208	73	41.0	30	16.9	41	23.0
Total	1,327	472		129		164	

Research Questions

This section will discuss and answer each of the seven research questions quantitatively. Frequencies and percentages from the data provided by the survey items will be used. Cross-tabulation of survey items and other referenced data was necessary to answer the research questions. Data are discussed and displayed in tables.

Question 1: "To what extent do Wisconsin's industry employers' perceptions of employment needs warrant the decline in specific Industrial Technology Department programs in Wisconsin's technical college districts?"

To help determine the answer to this question, data from several survey items, the data from the demographics of the populations for each of the programs, and data from the Wisconsin Technical College System reports regarding the decline and graduation rates for the programs studied were examined.

During the five year period covered from fiscal year 1996-1997 to fiscal year 2001-2002, graduation rates for Electronics, Mechanical Design, Machine Tool, and Welding related programs declined. The rates of decline varied by program with Welding graduation rates dropping 18%, Mechanical Design slipping 25%, Machine Tool Technics declining 47%, and Electronics dropping 54%. In 2004, the number of graduates of these programs was 280 from Electronics related programs, 143 from Mechanical Design programs, 184 from Machine Tool related programs, and 215 from Welding related programs (Wisconsin Technical College System, 2005).

Comparing the need for graduates in 2005, as reported by survey respondents, and the number of graduates in 2003-2004, suggests that the greatest disparity between available graduates and employee need is in the Machine Tool and Welding related career areas. Table 25 shows the minimum number of employees needed in each career area and the number of graduates from Wisconsin technical college districts in fiscal year 2003-2004.

Table 25.

2005 Employee Minimum Employee Needs and 2003-2004 Program Graduates

	Numbers	
Career Area	Employees Needed in 2005 (minimum)	2004 WTCS Graduates
Electronics	165	280
Mechanical Design	180	143
Machine Tool	444	184
Welding	322	215

Note. WTCS graduate numbers are the graduate totals of all related career programs.

The minimum number of employees needed by companies in 2005 exceeds the number of graduates from the four Industrial Technology programs studied. This study represented only a small sample of the total population. Based on the small sample size of this study and the minimum number of employees needed by respondents in 2005 the statewide decline in enrollments and graduates from the Industrial Technology Department programs related to Mechanical Design Technology, Machine Tool Technology, and Welding does not appear to be justified.

The minimum number of new employees needed, as reported by survey respondents, increases in 2006 over the 2005 employee need. This tends to indicate an even greater disparity between the number of graduates available from these programs

and the need for new employees as reported by respondents. Table 26 shows the minimum number of new employees needed by survey respondents for the years 2006 through 2010 for each of the four career areas studied. If the current graduation rate is indicative of the graduation rate through 2010, the need for employees in the Mechanical Design, Machine Tool, and Welding career areas, as reported by survey respondents, will not be met by the Wisconsin Technical College System. While it is not as obvious in the Electronics related career areas that the decline in graduates of Electronics related programs is not warranted, the sample size must be considered along with Department of Workforce Development projections for job openings in this field.

Table 26.

Minimum Number of New Employees Needed, By Program, 2006-2010

Program	2006	2007	2008	2009	2010
Electronics	189	129	129	114	111
Mechanical Design	209	153	148	120	113
Machine Tool	462	352	325	291	268
Welding	360	261	261	237	208

Question 2: "To what extent do industry perceptions of employment needs coincide with Department of Workforce projections?"

This question required looking at the state data collected by the survey and comparing it to the projections published by the Department of Workforce projections for

the years 2005 through 2010. The data from respondents who would hire from each of the four program areas were used and cross-tabulated with the perceived minimum employment needs for the years 2005 through 2010. Wisconsin Department of Workforce employment projections were calculated for each career area from the job categories that they related to and are shown in Table 27 along with the average minimum number of employees needed by respondents through 2010.

Table 27.

Average Yearly Employee Need Projections 2005-2010

	Projection Numbers	
Career Area	Department of Workforce Development	Average Employer Minimum
Electronics	700+	140
Mechanical Design	140	154
Machine Tool	900+	357
Welding	680+	275

Note. Department of Workforce Development projections for each career area were calculated by adding the numbers in a given career area for all related occupations as reported by graduates in graduate follow up surveys.

The sample size of employers surveyed was 1,549, which was estimated to be 26% of the population that would potentially hire graduates of the four programs studied. The total response rate of the sample population surveyed was 25.2%. This is estimated

to be 6.6% of the total population of employers in Wisconsin who would potentially hire graduates of the four industrial technologies programs studied.

There were 163 respondents that replied that they have or would potentially hire graduates of Electronics related programs. This represented 41.7% of the 391 survey respondents or 2.8% of the estimated population of industrial employers in Wisconsin that were considered in this study. An average minimum of 140 employees will be needed each year through 2010 by an average of 57.1% (n=97) of the employers who hire electronics related program graduates. Department of Workforce projections are that employers in Wisconsin will need approximately 700 electronics related employees each year. There is not enough information known regarding the total population size in Wisconsin of employers who would potentially hire electronics related program graduates of this study to determine how the data compares between the Department of Workforce projections and the study results.

There were 218 respondents that stated they have hired or would potentially hire graduates of mechanical design related programs. This represented 55.8% of the 391 survey respondents or 3.7% of the estimated population of industrial employers in Wisconsin that were considered in this study. An average minimum of 154 employees will be needed each year through 2010 by an average of 52.2% (n=114) of the employers who hire mechanical design related program graduates. Department of Workforce projections predict that employers in Wisconsin will need approximately 140 mechanical design related employees each year. There is not enough information known regarding the total population size in Wisconsin of employers who would potentially hire mechanical design related program graduates of this study to determine how the data

compares between the Department of Workforce projections and the study results. However, the minimum number of mechanical design related employees needed by respondents each year exceeds Department of Workforce projections.

There were 267 respondents that responded that they had hired or would potentially hire graduates of Machine tool related programs. This represented 68.3% of the 391 survey respondents or 4.5% of the estimated population of industrial employers in Wisconsin that were considered in this study. An average minimum of 357 machine tool related employees will be needed each year through 2010 by an average of 64.8% (n=173) of the employers who hire machine tool related program graduates. Department of Workforce projections predict that employers in Wisconsin will need approximately 900 machine tool related employees each year. There is not enough information known regarding the total population size in Wisconsin of employers who would potentially hire machine tool related program graduates of this study to determine how the data compares between the Department of Workforce projections and the study results.

There were 178 respondents that stated they had hired or would potentially hire graduates of welding related programs. This represented 45.5% of the 391 survey respondents or approximately 3.0% of the estimated population of industrial employers in Wisconsin that were considered in this study. An average minimum of 275 employees are going to be needed each year through 2010 by an average of 49.7% (n=97) of the employers who hire welding related program graduates. Department of Workforce projections predict that employers in Wisconsin will need approximately 680 welding related employees each year. There is not enough information known regarding the total population size in Wisconsin of employers who would potentially hire welding related

program graduates of this study to determine how the data compares between the Department of Workforce projections and the study results.

Extrapolation of the sample and study results to the total population of employers that would potentially hire graduates of the four programs studied will be discussed in the following paragraphs. However, extreme caution should be used when interpreting the results and determining the validity of the extrapolation for the following reasons:

- Larger companies tend to hire more employees than smaller companies
- The entire population consists of many companies with only one or two employees and these companies may not be representative of the hiring population of employers
- Cross tabulation and the percentages of companies hiring specific numbers of employees has not been done for this study and has not been considered in the extrapolation
- The distribution rate of the size of the companies for the total population is not known (the researcher could not determine this for 5,909 companies listed in the 2004 Wisconsin Manufacturers Directory)
- The study sample tended to favor participants that were known to hire graduates of the programs studied

If the 41.7% of respondents needing electronics related graduates were representative of the population of industrial employers, there would be 2,464 employers of electronics related graduates; and if 57.1% of these employers were hiring graduates of electronics related programs, 1,407 would be hiring electronics related employees each year through 2010. Based on the survey results, each employer that was hiring would hire

1.44 employees and the 1,407 employers that were hiring would need an average of 2,030 electronics career area employees each year through 2010.

If the 55.8% of respondents needing mechanical design related graduates were representative of the population of industrial employers, there would be 3,297 employers of mechanical design related graduates; and if 52.2% of these employers were hiring graduates of mechanical design related programs, 1,721 would be hiring mechanical design related employees each year through 2010. Based on the survey results, each employer that was hiring would hire 1.35 employees and the 1,721 employers that were hiring would need an average of 2,325 mechanical design related employees each year through 2010.

If the 68.3% of respondents needing machine tool related graduates were representative of the population of industrial employers, there would be 4,036 employers of machine tool related graduates; and if 64.8% of these employers were hiring graduates of machine tool related programs, 2,615 would be hiring machine tool related employees each year through 2010. Based on the survey results, each employer that was hiring would hire 2.06 employees and the 2,615 employers that were hiring would need an average of 5,387 machine tool related employees each year through 2010

If the 45.5% of respondents needing welding related graduates were representative of the population of industrial employers, there would be 2,689 employers of welding related graduates; and if 49.7% of these employers were hiring graduates of welding related programs, 1,336 would be hiring welding related employees each year through 2010. Based on the survey results, each employer that was hiring would hire

2.835 employees and the 1,336 employers that were hiring would need an average of 3,788 welding related employees each year through 2010.

Question 3: "Which industrial technology programs have more viability than others based on the projected need for graduates?"

In the year 2005, more than half of respondents who employ graduates from the four programs studied plan to hire employees who would receive training in those four programs. Seventy-three percent of those who hire Machine Tool program graduates intend to hire in 2005 and nearly two-thirds who hire Electronics and Welding program graduates plan to hire employees. Although the percentage of respondents who hire Mechanical design program graduates is lower than the other three, the percentage is still 57.8% for 2005. The need for employees increases in the year 2006, with 69.7% to 79.8% of respondents stating that they intend to hire employees from all four of the studied programs. Through the year 2008, more than half of all respondents plan to hire graduates of all four programs.

Indications are that all four programs will remain viable in the state of Wisconsin through the year 2010. However, the program that appears to have the most viability would be Machine Tool, in which 53.2% to 73.0% of respondents intend to hire between 268 and 462 employees in the years 2005 through 2010. Based on the number of employees needed, the Welding related programs tend to be the second most viable programs with 41.0% to 70.8% of respondents intending to hire 208 to 360 employees each year between 2005 and 2010. The Welding related programs are followed by the Electronics related programs and then by the Mechanical design programs, which has the

least reported need of the three programs. Although Mechanical Design is the least needed program based on the numbers of employees needed and the percentage of employers stating that they plan to hire employees, the percentages of respondents planning to hire Mechanical Design related employees in the years 2005 through 2010 is still relatively high as shown in Table 28.

Table 28.

Minimum Number of New Employees Needed 2005–2010 and Percentage of Respondents Planning to Hire

	Career Area			
Year	Electronics	Mechanical Design	Machine Tool	Welding
2005				
Minimum number	165	180	444	322
Percent Hiring	64.4	57.8	73.0	62.9
2006				
Minimum number	189	209	462	360
Percent Hiring	71.8	69.7	79.8	70.8
2007				
Minimum number	129	153	352	261
Percent Hiring	55.2	52.3	65.5	52.2

2008				
Minimum number	129	148	325	261
Percent Hiring	57	51.4	63.3	53.9
2009				
Minimum number	114	120	291	237
Percent Hiring	46	41.3	53.9	47.2
2010				
Minimum number	111	113	268	208
Percent Hiring	47.9	40.8	53.2	41.0

The perception of the need for employees tends to decline the farther out respondents were asked to predict. In large part, this appears to be due to uncertainty about the future as indicated by Graph 1. The farther out respondents are asked to predict, the greater the percentage of "unknown" responses and higher the lack of responses becomes.

Figures 2 through 5 are shown for visual comparisons between programs and between each of the six years from 2005 through 2010.

Figure 2 shows the number of companies hiring Electronics related employees and the number of new Electronics related employees needed for the years 2005 through 2010 in Wisconsin.

Figure 2.

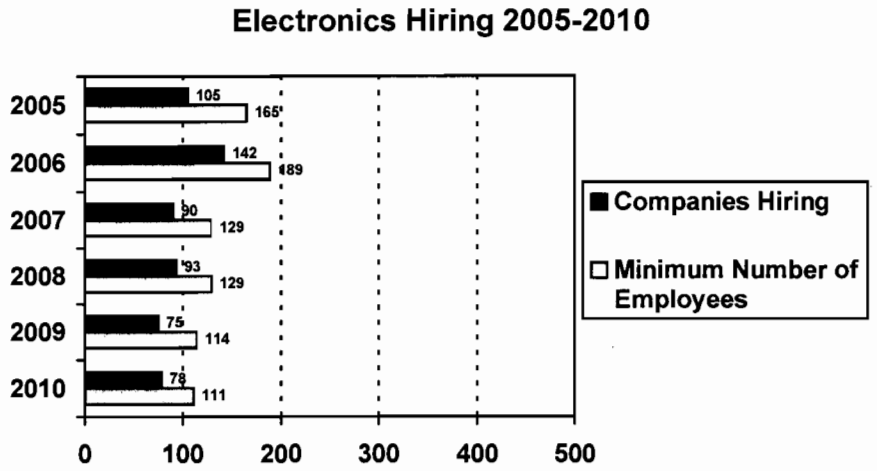


Figure 3 shows the number of companies hiring Mechanical Design related employees and the number of new Mechanical Design related employees needed for the years 2005 through 2010 in Wisconsin.

Figure 3.

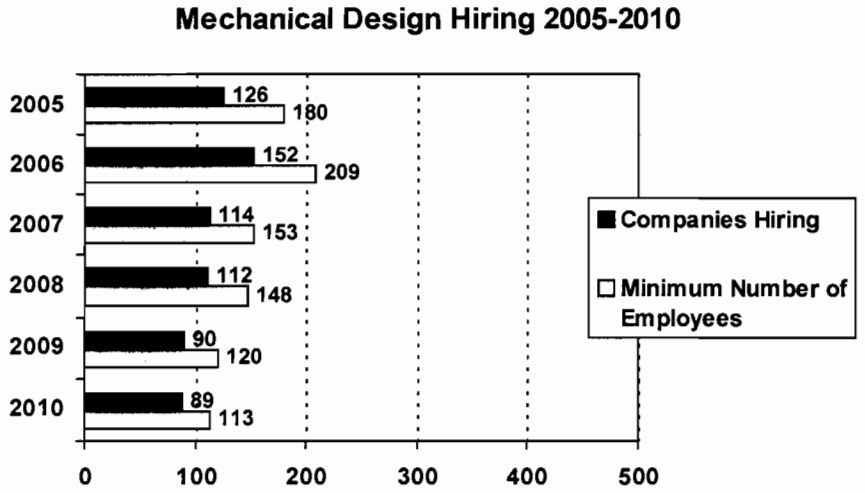


Figure 4 shows the number of companies hiring Machine Tool related employees and the number of new Machine Tool related employees needed for the years 2005 through 2010 in Wisconsin.

Figure 4.

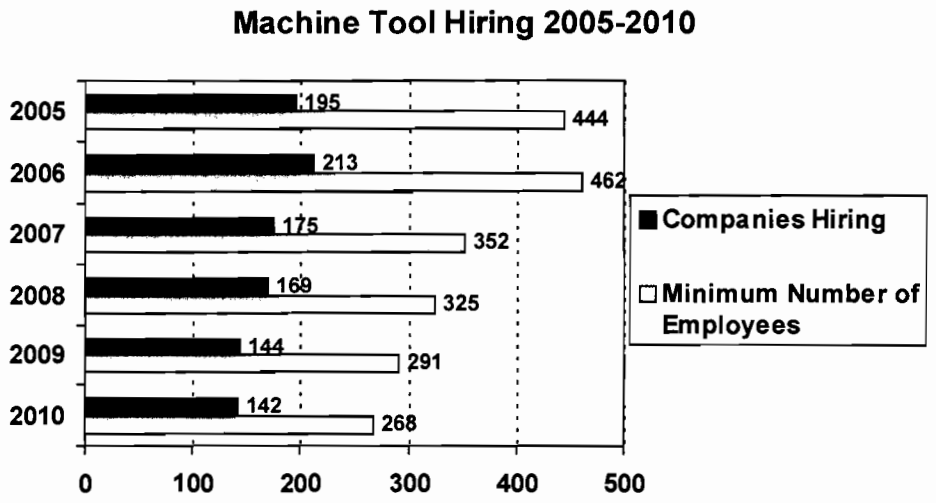
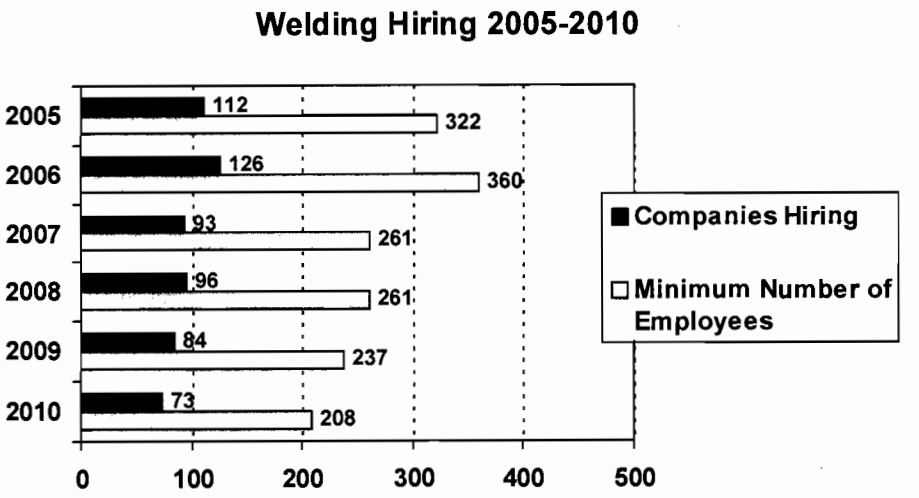


Figure 5 shows the number of companies hiring Welding related employees and the number of new Welding related employees needed for the years 2005 through 2010 in Wisconsin.

Figure 5.



Question 4: "In which technical college districts is there a greater need for specific Industrial Technology programs?"

To help determine the need for specific programs in each district, data for each program, in all 16 Wisconsin technical college districts, was calculated. Table 29 shows the percent of respondents that stated they hire from Electronics related programs, the percent of those who hire from this program that have had difficulty in the past year finding employees to fill positions in this program, the averaged percentage of respondents that plan to hire in the years 2005 through 2010, and the averaged minimum number of employees needed each year from 2005 through 2010.

There were only two districts, Moraine Park and Southwest Wisconsin, where fewer than 40% of respondents do not plan to hire electronics related employees through 2010. However, both of these districts may have been under represented in this career area in the sample received.

The district in which the greatest need for Electronics related programs exists is Milwaukee, where 100% of respondents reported difficulty finding employees and an average of 78.3% plan to hire through 2010.

The data from the Fox Valley, Gateway, Madison Area, Northcentral, and Northeast Wisconsin Technical College districts also tends to indicate a higher need for electronics related programs than the other districts. Each of these districts has more than half of respondents stating they have had difficulty finding employees in the past year, and the average minimum number of employees needed each year between 2005 and 2010 are sufficient to justify the programs without considering that the data represents only a sample of the entire population that would potentially hire from electronics related programs.

Table 29.

Employment Need for Electronics Related Career Areas

	%		Number[1]
District	Difficulty Finding Employees	Hiring 2005-2010 (Mean)	Employees Needed (Mean)
Blackhawk	25.0 (n=2)	43.8	4
Chippewa Valley	50.0 (n=7)	52.4	12
Fox Valley	64.2 (n=9)	51.2	17
Gateway	83.3 (n=5)	47.2	12
Lakeshore	66.7 (n=4)	69.5	5
Madison Area	65.2 (n=15)	61.6	18
Midstate	50.0 (n=2)	45.8	2
Milwaukee	100.0 (n=10)	78.3	11
Moraine Park	57.0 (n=4)	33.4	6
Nicolet	50.0 (n=1)	50.0	1
Northcentral	53.3 (n=8)	62.2	16
Northeast	52.6 (n=10)	70.2	19
Southwest	66.7 (n=4)	33.4	2
Waukesha	60.0 (n=3)	56.7	4
Western Wisconsin	36.4 (n=4)	45.5	6
Wisconsin Indianhead	10.0 (n=1)	60.0	8

The Chippewa Valley and Milwaukee Area Technical College districts were the two districts in which more than 60% of respondents cited difficulty finding employees to fill Mechanical Design open positions in 2005. As shown in Table 30, there were six districts, including Chippewa Valley and Milwaukee, in which an average of 16 or more mechanical design career area employees are expected to be needed each year through 2010. Respondents in the Northcentral and Northeast Wisconsin Technical College districts plan to hire an average of 20 or more Mechanical Design related employees each year through 2010. The average yearly minimum number of employees needed in the Fox Valley and Madison Area Technical College districts also tend to indicate sufficient numbers of employees needed to support continuing Mechanical Design programs in those districts.

Table 30.

Employment Need for Mechanical Design Related Career Areas

	%		Number[1]
District	Difficulty Finding Employees	Hiring 2005-2010 (Mean)	Employees Needed (Mean)
Blackhawk	44.4 (n=4)	55.5	6
Chippewa Valley	62.3 (n=9)	48.8	16
Fox Valley	42.1 (n=8)	56.2	18
Gateway	36.4 (n=4)	62.1	8
Lakeshore	33.3 (n=2)	63.9	5
Madison Area	21.4 (n=6)	43.5	17
Midstate	50.0 (n=1)	33.3	1
Milwaukee	63.6 (n=14)	60.6	19
Moraine Park	46.2 (n=6)	51.3	8
Nicolet	100 (n=1)	100	1
Northcentral	50.0 (n=11)	67.4	29
Northeast	32.0 (n=8)	56.7	20
Southwest	50.0 (n=1)	--	--
Waukesha	33.3 (n=4)	45.8	7
Western Wisconsin	35.7 (n=5)	29.8	5
Wisconsin Indianhead	46.7 (n=7)	47.8	8

In the districts of Moraine Park and Gateway Technical Colleges, there were more than 83% of respondents reporting that they have had difficulty finding workers to fill positions in the Machine Tool career area. An average of more than 70% of respondents in these two districts plan to hire each year through 2010 and they report that they need a minimum of more than 20 employees each year through 2010.

There are 13 of the 16 districts in which there would be sufficient numbers of employees as shown in Table 31 needed each year to support continuing Machine Tool programs without considering the small representative sample size of respondents. The three districts where the data does not indicate as much need as in the other 13 districts are Nicolet, Midstate, and Southwest Technical College districts.

Table 31.

Employment Need for Machine Tool Related Career Areas

	%		Number[1]
District	Difficulty Finding Employees	Hiring 2005-2010 (Mean)	Employees Needed (Mean)
Blackhawk	44.4 (n=4)	77.8	13
Chippewa Valley	62.5 (n=10)	54.2	20
Fox Valley	48.0 (n=12)	60.7	33
Gateway	83.3 (n=15)	72.2	24
Lakeshore	75.0 (n=6)	79.2	13
Madison Area	37.0 (n=10)	55.5	22
Midstate	83.3 (n=5)	69.5	6
Milwaukee	67.7 (n=21)	76.9	61
Moraine Park	84.2 (n=16)	76.3	27
Nicolet	100 (n=1)	83.3	1
Northcentral	42.3 (n=11)	65.4	37
Northeast	70.0 (n=14)	69.2	39
Southwest	75.0 (n=3)	33.3	4
Waukesha	81.3 (n=13)	55.2	16
Western Wisconsin	52.9 (n=9)	52.9	15
Wisconsin Indianhead	59.1 (n=13)	57.6	33

Data, as shown in Table 32, suggests that the Northeast Wisconsin Technical College district has the most urgent need for graduates of welding related programs. Nearly three-fourths of respondents who hire welding employees had difficulty finding qualified employees to fill positions in the past year, an average of 72.8% plan to hire each year through 2010, and the average minimum number of employees needed each year is 38.

While the need for employees was most desperate in the Northeast Wisconsin Technical College district, there were ten districts in which more than 50% of respondents reported difficulty finding qualified workers in the past year and 14 of the 16 districts report needing sufficient numbers of employees each year that it would be justified to continue these programs. While the need for welding employees was not as apparent in the Mid-State and Southwest Wisconsin Technical College districts, the sample size of respondents may not have been of sufficient size to determine the need for welding programs.

Table 32.

Employment Need for Welding Related Career Areas

	%		Number[1]
District	Difficulty Finding Employees	Hiring 2005-2010 (Mean)	Employees Needed (Mean)
Blackhawk	66.7 (n=4)	63.9	20
Chippewa Valley	60.0 (n=6)	41.7	12
Fox Valley	45.0 (n=9)	55.8	25
Gateway	50.0 (n=3)	72.2	60
Lakeshore	60.0 (n=3)	66.7	10
Madison Area	42.1 (n=8)	50.9	19
Midstate	60.0 (n=3)	36.7	3
Milwaukee	46.0 (n=6)	60.2	28
Moraine Park	77.7 (n=7)	61.1	16
Nicolet	100.0 (n=2)	91.7	10
Northcentral	50.0 (n=9)	52.8	38
Northeast	73.7 (n=14)	72.8	38
Southwest	50.0 (n=3)	47.2	5
Waukesha	55.6 (n=5)	48.2	11
Western Wisconsin	60.0 (n=9)	44.5	17
Wisconsin Indianhead	66.7 (n=10)	55.6	25

Question 5: "To what extent do employers have difficulty finding qualified workers to fill open positions in selected areas?"

More than half of the employers in Wisconsin who responded to the survey stated that they have had difficulty finding qualified workers in the Electronics, Machine Tool, and Welding related career areas in the past year. Those who hire Machine Tool related workers reported the greatest difficulty, with 61.8% stating they have had difficulty finding workers to fill positions. Table 33 shows the number of respondents that stated their company hires graduates in each career area and the percentages of respondents reporting them having difficulty finding qualified workers in the past year that hire in each career area. Respondents that replied "no" to the question are not included because there were many negative responses from respondents who do not hire from each career area.

Table 33.

Difficulty Finding Qualified Workers in Past Year-State Data

	Report Difficulty		Hire in this Area
Career Area	%	n	n
Electronics	55.8	91	163
Mechanical Design	41.7	91	218
Machine Tool	61.8	165	267
Welding	57.3	102	178

There were eight districts in which more than half of the respondents reported difficulty finding qualified workers for positions in Electronics related career areas. Table 34 shows the percentage and number of respondents who hire Electronics related program graduates that report difficulty finding qualified workers in each Wisconsin technical college district. Respondents in the Milwaukee Area Technical College district (100%) reported the most trouble finding qualified workers, followed by the Gateway Technical College district (83.3%).

Table 34.

Difficulty Finding Qualified Workers in Electronics Career Area by District

	Report Difficulty		Hire in this Area
District	%	n	n
Blackhawk	25.0	2	8
Chippewa Valley	50.0	7	14
Fox Valley	64.2	9	14
Gateway	83.3	5	6
Lakeshore	66.7	4	6
Madison Area	65.2	15	23
Midstate	50.0	2	4
Milwaukee	100.0	10	10
Moraine Park	57.0	4	7
Nicolet	50.0	1	2
Northcentral	53.3	8	15
Northeast	52.6	10	19
Southwest	66.7	4	6
Waukesha	60.0	3	5
Western Wisconsin	36.4	4	11
Wisconsin Indianhead	10.0	1	10

Table 35 shows the results of cross-tabulated data for the number of respondents in each district that reported difficulty finding qualified workers in the Mechanical Design related career area. There were only two districts in which more than half of the respondents reported difficulty finding qualified workers in this career area; these were the Chippewa Valley (62.3%) and Milwaukee Area (63.6%) Technical College districts. While there were insufficient numbers of respondents who hire Mechanical Design graduates in the Nicolet, Mid-State, and Southwest Technical College districts, 50% of the respondents in those districts indicated they had trouble finding mechanical design related employees. In the technical college districts of Blackhawk, Fox Valley, Northcentral, and Wisconsin Indianhead, there were a larger number of respondents hiring from the mechanical design related career area and more than 40% of the respondents in those districts reported difficulty finding workers.

Table 35.

Difficulty Finding Qualified Workers in Mechanical Design Career Area by District

	Report Difficulty		Hire in this Area
District	%	n	n
Blackhawk	44.4	4	9
Chippewa Valley	62.3	9	14
Fox Valley	42.1	8	19
Gateway	36.4	4	11
Lakeshore	33.3	2	6
Madison Area	21.4	6	28
Midstate	50.0	1	2
Milwaukee	63.6	14	22
Moraine Park	46.2	6	13
Nicolet	50.0	1	1
Northcentral	50.0	11	22
Northeast	32.0	8	25
Southwest	50.0	1	2
Waukesha	33.3	4	12
Western Wisconsin	35.7	5	14
Wisconsin Indianhead	46.7	7	15

More than half of the respondents in 11 of the 16 technical college districts reported difficulty finding qualified workers in Machine Tool related career areas. Moraine Park (84.2%), Gateway (83.3%), Midstate (83.3%), and Waukesha (81.3%) were the districts reporting the greatest difficulty finding qualified Machine Tool related workers. In all 16 technical college districts, at least two-thirds of respondents indicated difficulty finding qualified workers to fill positions. Table 36 shows the number of companies hiring machine tool related employees and the number and percentage of those who have difficulty finding workers.

Table 36.

Difficulty Finding Qualified Workers in Machine Tool Career Area by District

	Report Difficulty		Hire in this Area
District	%	n	n
Blackhawk	44.4	4	9
Chippewa Valley	62.5	10	16
Fox Valley	48.0	12	25
Gateway	83.3	15	18
Lakeshore	75.0	6	8
Madison Area	37.0	10	27
Midstate	83.3	5	6
Milwaukee	67.7	21	31
Moraine Park	84.2	16	19
Nicolet	50.0	1	1
Northcentral	42.3	11	26
Northeast	70.0	14	20
Southwest	75.0	3	4
Waukesha	81.3	13	16
Western Wisconsin	52.9	9	17
Wisconsin Indianhead	59.1	13	22

More than half of the respondents in 10 of the 16 technical college districts who indicated their companies hire graduates from Welding related career areas have had difficulty finding qualified workers in the past year. Respondents in the Moraine Park (77.7%), Nicolet (100%), and Northeast Wisconsin (73.7%) Technical College districts reported the most difficulty finding qualified workers to fill welding related positions. Table 37 shows the number of respondents who hire Welding related program graduates in each district and the number and percentage of respondents who have had difficulty finding qualified workers in the past year.

Table 37.

Difficulty Finding Qualified Workers in Welding Career Area by District

	Report Difficulty		Hire in this Area
District	%	n	n
Blackhawk	66.7	4	6
Chippewa Valley	60.0	6	10
Fox Valley	45.0	9	20
Gateway	50.0	3	6
Lakeshore	60.0	3	5
Madison Area	42.1	8	19
Midstate	60.0	3	5
Milwaukee	46.0	6	13
Moraine Park	77.7	7	9
Nicolet	100.0	2	2
Northcentral	50.0	9	18
Northeast	73.7	14	19
Southwest	50.0	3	6
Waukesha	55.6	5	9
Western Wisconsin	60.0	9	15
Wisconsin Indianhead	66.7	10	15

Question 6: "What are industrial employers' short-term needs for graduates of Industrial Technology programs?"

In all four programs studied there was an increase in the number of employees needed from 2005 to 2006 for the statewide responses. This increase ranged from 4% for Machine Tool related careers to 16% for Mechanical Design related careers.

In the electronics related career areas, 64.4% of respondents intended to hire at least 165 employees in 2005. In 2006, responses indicated that employers would need approximately 15% more electronics employees than in 2005. For 2006, the number of respondents planning to hire increased to 71.8%, with a minimum of 189 employees needed. Table 38 shows the minimum number of employees needed for 2005 and 2006, the percentage of respondents hiring in those years, and the percentage of respondents that stated they did not know how many or if they would need employees in 2005. Additionally, the numbers and percentages of respondents who do not plan to hire any Electronics related employees and those who did not respond to the survey item are shown in Table 38.

Table 38.

Respondent Need for Electronics Related Employees—2005-2006

	2005		2006	
Electronics	n	%	n	%
Employees Needed—Minimum	165		189	
Hiring Employees	105	64.4	142	71.8
Unknown	26	16.0	25	15.3
Zero Employees Needed	--	--	15	9.2
No Response	32	19.6	6	3.6

Table 39 shows the minimum number of electronics related career area employees needed by respondents in each Wisconsin technical college district for 2005 and 2006. This table also shows the percent and number of respondents that plan to hire in those districts in 2005 and 2006. More than half of respondents in the majority of the districts plan to hire in 2005 and 2006, with the Milwaukee Area Technical College District showing the greatest percentage of hiring in both 2005 (90%) and 2006 (100%). Madison Area, Northcentral, and Northeast Wisconsin Technical College districts respondents indicated that they would need higher numbers of electronics employees than in other technical college districts for 2005 and 2006.

Table 39.

Respondent Need, By District, for Electronics Related Employees—2005-2006

	2005		2006	
District	n	% (n)	n	% (n)
Blackhawk	5	62.5 (n=5)	5	62.5 (n=5)
Chippewa Valley	13	78.6 (n=11)	13	50.0 (n=7)
Fox Valley	14	57.1 (n=8)	18	64.3 (n=9)
Gateway	12	50.0 (n=3)	16	66.7 (n=4)
Lakeshore	7	66.7 (n=4)	6	100 (n=6)
Madison Area	19	69.6 (n=16)	24	78.3 (n=18)
Midstate	1	25.0 (n=1)	2	50.0 (n=2)
Milwaukee	15	90.0 (n=9)	16	100 (n=10)
Moraine Park	4	57.1 (n=4)	6	42.9 (n=3)
Nicolet	1	50.0 (n=1)	1	50.0 (n=1)
Northcentral	20	53.3 (n=8)	21	80.0 (n=12)
Northeast	14	73.7 (n=14)	18	78.9 (n=15)
Southwest	3	50.0 (n=3)	4	66.7 (n=4)
Waukesha	7	80.0 (n=4)	7	80.0 (n=4)
Western Wisconsin	11	45.5 (n=5)	6	54.5 (n=6)
Wisconsin Indianhead	10	70.0 (n=7)	17	80.0 (n=8)
Total	156		180	

Respondents who hire mechanical design employees will need a minimum of 180 employees in 2005, with 57.8% stating that they plan to hire in 2005. The number of employees needed increases by approximately 16% in 2006, with a minimum of 209 employees needed by respondents. Table 40 shows the percentages for 2005 and 2006 of respondents who plan to hire, the minimum number of new or replacement employees needed.

Table 40.

Respondent Need for Mechanical Design Related Employees—2005-2006

	2005		2006	
Mechanical Design	n	%	n	%
Employees Needed—Minimum	180		209	
Hiring Employees	126	57.8	152	69.7
Unknown	24	11.0	20	9.2
Zero Employees Needed	65	29.8	18	8.3
No Response	--	--	28	12.8

The majority of respondents that would potentially hire graduates of mechanical design programs intend to hire in both 2005 and 2006 in 11 of the 16 technical college districts. Table 41 shows the minimum numbers of employees needed by respondents in

each Wisconsin technical college district and the percentages of respondents that intend to hire in 2005 and 2006. In the Lakeshore Technical College district, 100% of respondents intend to hire at least nine employees in both 2005 and 2006. Northcentral, Northeast Wisconsin, Fox Valley, and Chippewa Valley Technical College district respondents cite the need for an average of 20 new or replacement employees for 2005 and 2006.

Table 41.

Respondent Need, By District, for Mechanical Design Related Employees—2005-2006

	2005		2006	
District	n	% (n)	n	% (n)
Blackhawk	8	88.9 (n=8)	7	77.8 (n=7)
Chippewa Valley	21	64.3 (n=9)	21	64.3 (n=9)
Fox Valley	18	63.2 (n=12)	24	73.7 (n=14)
Gateway	7	63.6 (n=7)	12	81.9 (n=9)
Lakeshore	9	100 (n=6)	9	100 (n=6)
Madison Area	14	50.0 (n=14)	25	67.9 (n=19)
Midstate	--	--	1	50.0 (n=1)
Milwaukee	23	63.6 (n=14)	22	86.4 (n=19)
Moraine Park	9	69.2 (n=9)	8	61.5 (n=8)
Nicolet	1	100 (n=1)	1	100 (n=1)
Northcentral	30	68.2 (n=15)	25	72.7 (n=16
Northeast	18	48.0 (n=12)	28	76.0 (n=19)
Southwest	--	--	--	--
Waukesha	10	58.3 (n=7)	11	66.7 (n=8)
Western Wisconsin	4	28.6 (n=4)	5	35.7 (n=5)
Wisconsin Indianhead	11	53.5 (n=8)	9	60.0 (n=9)
Total	183		208	

Of the 267 respondents that stated that they hire or would potentially hire graduates of machine tool related programs, 73% planned to hire a minimum of 444 employees in 2005. Four percent more employees were expected to be needed by 79.8% of respondents who hire in the machine tool career area in the year 2006. Table 42 shows the percentages of responses for 2005 and 2006 of employers who intend to hire, who are unsure, did not respond, or do not plan to hire for those years.

Table 42.

Respondent Need for Machine Tool Related Employees—2005-2006

	2005		2006	
Machine Tool	n	%	n	%
Employees Needed—Minimum	444		462	
Hiring Employees	195	73.0	213	79.8
Unknown	23	8.6	19	7.1
Zero Employees Needed	49	18.4	12	4.5
No Response	--	--	23	8.6

Fifty percent or more of respondents in all 16 Wisconsin technical college districts plan to hire employees in the machine tool career areas in 2005 and 2006. As shown in Table 43, there is an average of more than 20 employees needed each year in 11

of the technical college districts for 2005 and 2006. The greatest need for employees of machine tool related employees occurs in the Fox Valley, Gateway, Milwaukee Area, Moraine Park, Northcentral, Northeast Wisconsin, and Wisconsin Indianhead Technical College districts. In the Milwaukee Area Technical College district, 90.3% of respondents plan to hire a minimum of 73 machine tool related career area employees in 2006.

Table 43.

Respondent Need, By District, for Machine Tool Related Employees—2005-2006

	2005		2006	
District	n	% (n)	n	% (n)
Blackhawk	14	88.9 (n=8)	14	88.9 (n=8)
Chippewa Valley	33	75.0 (n=12)	15	56.3 (n=9)
Fox Valley	46	76.0 (n=19)	42	72.0 (n=18)
Gateway	28	88.9 (n=16)	37	88.9 (n=16)
Lakeshore	17	100 (n=8)	19	87.5 (n=7)
Madison Area	29	64.0 (n=17)	25	70.4 (n=19)
Midstate	7	66.7 (n=4)	11	83.3 (n=5)
Milwaukee	67	80.6 (n=25)	73	90.3 (n=28)
Moraine Park	41	89.5 (n=17)	28	84.2 (n=16)
Nicolet	1	100 (n=1)	1	100 (n=1)
Northcentral	38	65.4 (n=17)	46	84.6 (n=22)
Northeast	34	50.0 (n=10)	52	80.0 (n=16)
Southwest	2	50.0 (n=2)	2	50.0 (n=2)
Waukesha	24	75.0 (n=12)	19	81.3 (n=13)
Western Wisconsin	20	64.7 (n=11)	24	70.6 (n=12)
Wisconsin Indianhead	42	68.2 (n=15)	38	77.3 (n=17)
Total	443		446	

Table 44 shows the minimum number of employees needed in 2005 and 2006 by respondents that stated they hire or would potentially hire graduates of welding related programs. Also shown are the percentages of respondents hiring employees, those who are unsure of hiring, non-respondents, and those who do not plan to hire in those years. In 2005, a minimum of 322 employees will be needed by 62.9% of respondents statewide in Wisconsin. The need for employees in the welding related career areas increases by approximately 12% in 2006 with 70.8% of respondents citing a need for a minimum of 360 employees statewide.

Table 44.

Respondent Need for Welding Related Employees—2005-2006

	2005		2006	
Welding	n	%	n	%
Employees Needed—Minimum	322		360	
Hiring Employees	112	62.9	126	70.8
Unknown	30	16.9	19	10.7
Zero Employees Needed	36	20.2	16	9.0
No Response	--	--	17	1.0

In eight of the sixteen technical college districts, respondents cited the need for 20 or more employees in 2005 and 2006. Table 45 shows the responses for each of the 16 Wisconsin technical college districts regarding the need for welding related career area employees in 2005 and 2006. The minimum number of employees needed is shown for each district along with the percentage of respondents that stated they would need new or replacements employees in those years.

There were 12 technical college districts in which 50% or greater of respondents stated they plan to hire welding career area employees in 2005. In 2006, there were 15 districts in which 50% or more of the respondents expected to hire employees from this career area. The largest numbers of employees needed by respondents were in the Milwaukee Area, Northcentral, and Northeast Wisconsin Technical College districts.

Table 45.

Respondent Need, By District, for Welding Related Employees—2005-2006

	2005		2006	
District	n	% (n)	n	% (n)
Blackhawk	25	66.7 (n=4)	23	83.3 (n=5)
Chippewa Valley	21	90.0 (n=9)	12	60.0 (n=6)
Fox Valley	21	60.0 (n=12)	26	55.0 (n=11)
Gateway	3	50.0 (n=3)	9	50.0 (n=3)
Lakeshore	10	80.0 (n=4)	10	80.0 (n=4)
Madison Area	22	68.4 (n=13)	27	68.4 (n=13)
Midstate	1	80.0 (n=4)	2	40.0 (n=2)
Milwaukee	33	69.2 (n=9)	39	69.2 (n=9)
Moraine Park	25	77.8 (n=7)	15	66.7 (n=6)
Nicolet	11	100 (n=2)	8	100 (n=2)
Northcentral	39	50.0 (n=9)	44	77.8 (n=14)
Northeast	46	68.4 (n=13)	46	84.2 (n=16)
Southwest	9	50.0 (n=3)	10	66.7 (n=4)
Waukesha	12	67.7 (n=6)	14	55.6 (n=5)
Western Wisconsin	22	46.7 (n=7)	25	66.7 (n=10)
Wisconsin Indianhead	22	46.7 (n=7)	28	86.7 (n=13)
Total	322		338	

Question 7: "What is the perception of the need for graduates of these programs through the year 2010?"

Based on the survey responses for survey items 12 and 13, there is a need for graduates of all four programs studied from 2005 through 2010, with respondents having the most confidence in their hiring requirements in the year 2006. In subsequent years, the number of respondents that are unsure about the number or employees needed increases as the number of respondents that know the number of employees decreases. The data for employee needs for years 2006 through 2010, as shown in Tables 21, 22, 23, and 24, tends to indicate that while respondents are less sure about the numbers of employees they expect to hire, the percentage of respondents that state they will need zero new employees does not increase for those years. This tends to suggest that these respondents perceive that they will need employees in the future, but they are not sure of the numbers.

Summary of Findings

The purpose of this study was to determine the extent to which industrial employers in Wisconsin needed graduates of the Wisconsin's technical colleges in the four program areas of Electronics, Mechanical Design, Machine Tool and Welding through the year 2010. In this study, survey respondents were represented in all 16 Wisconsin technical college districts, with 88.5% having hired graduates of the Wisconsin technical colleges in the past. Manufacturing companies of all sizes, from fewer than 10 employees to more than 500 employees were represented by survey respondents.

Survey respondents reported some difficulty in finding workers to fill open positions in all four programs studied with the Machine Tool cited as the career area in which they had the most difficulty finding workers. The reasons that respondents believed they had difficulty finding qualified workers varied, but 50% stated that applicants did not have the skills required for the positions, 21.5% stated that applicants did not have the degree or credentialing required, and 18.2% stated there were no applicants for open positions.

In 2005, 78% of respondents plan to hire new employees due to company growth and 52.5% plan to hire due to attrition. Respondents are more confident in their hiring plans in the years 2005 and 2006 than in the years 2007 through 2010. They expect to hire more new and replacement employees in the years 2006 than in the other years studied. However, respondents expect to hire more employees in the years 2005 through 2010 from three of the career areas studied than there are Wisconsin technical college graduates to fill the positions. If the sample size is considered, there will not be enough graduates in any of the four Wisconsin technical college program areas studied to meet the employment needs of Wisconsin's manufacturers in the year 2005. Current trends based on hiring expectations, the decline in Industrial Technology program graduates, and the fact that half of all respondents cite a skills shortage of applicants for positions tends to indicate there will be a more severe shortage of qualified workers through 2010 in Wisconsin.

CHAPTER FIVE

Summary, Conclusions, and Recommendations

Introduction

This chapter will include a summary that states the problem that led to the investigation of the problem, methods and procedures used in the study, and the major findings of the study. A second section will discuss the research questions and conclusions that were reached as a result of the data acquired and the literature that was reviewed. Recommendations that are related to this study and recommendations for further research will be presented in the last section of this chapter.

Summary

This section of chapter five will restate the problem investigated, explain the methods and procedures used, and describe the major findings of this study.

Problem Statement

Due to declining enrollments in the Wisconsin Technical College System's Industrial Technology department programs and budget constraints, college administrators have been forced to decrease staff and discontinue programs. Wisconsin's Department of Workforce Development job projections indicate that there will be many openings for graduates of some of these programs and studies conducted of manufacturing companies predict shortages of workers with the skills learned in these programs. Because of the significant decline in manufacturing jobs in the past three years, there is a need to know if employers who would potentially hire program graduates

have the same perception of the need for new employees in the future as the projections indicate. It would not be ethical to market programs for which graduates would not be able to find employment. It is unknown to what extent industry employers have a need for graduates of the welding, machine tool, electronics, and mechanical design industrial technology programs in the Wisconsin Technical College Districts.

Methods and Procedures

This study was designed to determine the extent to which industrial employers in each of the 16 Wisconsin Technical College System (WTCS) districts will need graduates of Electronics, Mechanic Design, Machine Tool, and Welding related programs through 2010 in Wisconsin.

There were approximately 12,000 manufacturing in Wisconsin in 2004 with an estimated 5,900 that would potentially hire employees that have graduated from the four program areas studied. These estimates were based on the SIC classification system and data obtained from the 2004 Wisconsin Manufacturer's Directory (Harris Infosource, 2003).

The survey used for this study had several questions designed to collect demographic data from respondents and to determine what career areas employers hire employees from. Additionally, the survey sought to determine respondents' perception of their need for graduates in the year 2005 and each year through 2010, the extent to which they are currently having difficulty finding qualified workers, and their perception of the factors affecting hiring practices at their company.

The survey sample was selected by using the most recent WTCS graduate follow-up reports available for a five year period from each of the 16 technical college districts. In most districts, these reports were for the years 1998 through 2003. The companies in Wisconsin that graduates reported that they were employed by were selected for inclusion in the survey sample. From these reports, it was determined that there were 1,118 Wisconsin employers that were probably still in business that had hired graduates of Electronics, Mechanical Design, Machine Tool, and Welding related programs. A target sample size of 1,600 was selected to represent all 16 technical college districts and to compensate for an anticipated low response rate. The 2004 Wisconsin Manufacturer's Directory (Infosource, 2003) was used to systematically select an additional 501 companies to reach the desired survey sample size. This resulted in a total sample size of 1,619.

A pilot study was conducted in November 2004 to determine the best method of distributing the survey to participants and so that modifications could be made to the survey instrument if pilot study responses indicated that they were needed. There were 19 surveys sent to recipients in Madison, Milwaukee, Racine, and Appleton via United States Postal Service first class mail and 11 surveys were sent using Internet e-mail addresses. These cities were selected based on district size, city size and the large population of manufacturers in each city. Based on the results of returns from the pilot study and the difficulty with e-mail recipients receiving surveys, it was determined that the surveys should be send via the United States Postal Service for the main study and that e-mail should not be used.

The survey used for data collection consisted of five pages with the first page consisting of a description of the study, the potential risks and benefits of participation, a confidentiality statement, informed consent statement, and research contact information. A cover letter, the survey, and a postage paid return envelope were sent to recipients via United States Postal Service from Western Wisconsin Technical College using bulk mail with return service requested. Surveys were sent the second week of February 2005 and participants were asked to respond by March 10, 2005. After 20 days, reminder notices were sent via first class mail to survey recipients. Data collection was completed by March 31, 2005.

Of the 1,619 surveys sent, 44 were non-deliverable due to address changes and/or companies no longer being in business; 18 surveys were not applicable to the recipient company and two surveys were determined to be duplicated companies. There were 397 surveys returned by March 31, 2005 for a return rate of 25.5%. However, six respondents chose not to participate, which resulted in 391 valid surveys for this study from 1,549 potential Wisconsin recipients. This resulted in a response rate of 25.1%. Respondents from all 16 Wisconsin technical college districts were represented with response rates ranging from 14% in the Nicolet Area Technical College district to 35% in the Northcentral Technical College district.

Data from the surveys was coded and entered into spreadsheets and was analyzed using Statistical Package for the Social Sciences (SPSS®) version 13.0 computerized statistics software. Descriptive statistical analysis was used to analyze data in this study. Frequencies and percentages were calculated for statewide demographic data and employment projections. Cross-tabulation was used to segregate each of the four

programs and the 16 technical college districts for specific data frequencies and percentages.

Major Findings

Survey respondents in this study represented all 16 Wisconsin Technical College System districts and companies employing from fewer than 10 employees to more than 501 employees. The greatest representation (33.2 %) was from companies employing 11 to 50 employees. All four Industrial Technology program areas studied were represented by respondents with 163 hiring graduates of Electronics career areas, 218 hiring graduates of Mechanical Design career areas, 267 hiring graduates of Machine Tool career areas, and 178 hiring graduates of Welding career areas. The majority of respondents, 88.5%, had hired graduates of the WTCS districts in the past.

In the past year (2004-2005) respondents reported difficulty finding qualified workers for open positions in all four program areas studied. In the machine tool career area, 61.8% of respondents reported difficulty finding employees; in welding career areas 57.3% reported difficulty; for electronics related careers areas, 55.8% report difficulty finding workers; and 41.7% report having difficulty finding workers in the mechanical design career areas. When survey respondents were asked what they believed the reasons were for difficulty finding qualified workers, 50.6% of respondents stated that the applicants did not have the skills required for the position applied for, 30.4% stated that applicants didn't have prior work experience that was required, 21.5% reported the lack of required degrees or credentialing, and 18.2% reported there were no applicants for open positions. Only 4.3% of respondents stated that technology changes at their

company required employees with higher levels of skills than those of technical college graduates who have applied for positions.

Other factors that have impacted the hiring practices of survey respondents in the past year were the "slowdown of the economy" with 36.8% citing this as a factor, lack of work orders (32.5%), more in-house training (20.5%), and technology changes that require fewer employees (16.1%). Eleven percent of respondents stated that "lack of funds" had affected their hiring practices in the past year.

In Wisconsin, 78% of respondents stated that their companies plan to hire new employees due to growth in 2005. The Wisconsin technical college districts in which respondents anticipated the greatest need for new employees due to growth were the Chippewa Valley and Lakeshore Technical College districts. Statewide, 52.5% of respondents indicated that they plan to hire new employees for reasons other than growth in 2005. Respondents from the Lakeshore (63.6%), Blackhawk (61.5%) Fox Valley (61.8%), and Milwaukee Area (61%) Technical College districts had the greatest expectations for hiring in 2005 due to retirements and replacing workers.

Survey respondents were asked to estimate the numbers of new employees they would need in 2005 for each of the four career areas studied. Based on their selections, the minimum number of new employees needed for each career areas was calculated. The number of graduates from the WTCS districts in 2004 for these career areas was used to help determine the extent to which the Industrial Technology programs were needed in each of the districts and statewide. In 2005, respondents who hire employees in the machine tool career areas will need a minimum of 444 new employees, while the WTCS graduated 184 students from Machine Tool related programs in 2004. Respondents who

hire welding employees report the need for a minimum of 322 new employees and there were 215 graduates in 2004 from WTCS districts to fill open positions. There was a reported need for a minimum of 180 new employees in 2005 by respondents who hire mechanical design career area employees, but only 143 graduates Mechanical Design programs in the WTCS districts in 2004. In the electronics career areas, respondents reported the need for a minimum of 165 new employees in 2005 and there were 280 WTCS graduates in 2004 to fill open positions.

Based on the relatively small sample size of this study and the reported need by respondents for new or replacement employees in 2005, there will not be enough graduates of Machine Tool, Mechanical Design, or Welding programs in the WTCS districts to fill open positions in 2005. Although the data comparisons for Electronics related career areas does not clearly indicate insufficient Electronics program graduates to fill open positions, the sample size, survey respondent need, and Department of Workforce Development projections would have to be considered when evaluating the need for this program in each technical college district.

In all six years examined by this study, 2005 through 2010, respondents that hire machine tool career area employees cited the greatest need for employees. Seventy three percent plan to hire in 2005 and 79.8% plan to hire in 2006. Between 2005 and 2010, the percent who plan to hire in the machine tool career areas ranges from 53.2 to 65.5%.

The expectations of respondents for hiring new and replacement employees between 2005 and 2010 in the electronics and welding career areas is very similar with approximately 63% planning to hire in 2004 and 71% in 2005. For the years 2007

through 2010, the percentage of respondents who intend to hire in these career areas ranges from 41% to 55%.

Although the Mechanical Design program tends to be the least needed program in the study based on the minimum number of employees needed and the percentage of respondents that plan to hire employees, the percent of respondents that plan to hire is still relatively high, ranging from 69.7% in 2006 to 40.8% in 2010.

The four programs studied were needed in all 16 Wisconsin Technical College System districts; however, data collected suggested that there may be more need for some programs over others in most districts. Electronics related programs appeared to be most needed in the Milwaukee Area Technical College district with 100% of respondents that hire from electronics career areas citing difficulty finding employees and an average of 78.3% planning to hire each year through 2010. Other districts that had a high rate of difficulty finding employees to fill positions combined with a relatively high average number of employees needed and with more than 47% of respondents intending to hire each year through 2010 were the Fox Valley, Gateway, Madison Area, Northcentral, and Northeast Wisconsin Technical College districts.

The districts in which mechanical design employees were needed the most were the Milwaukee Area, Chippewa Valley, Northcentral, Northeast Wisconsin, Fox Valley, and Madison Area Technical College districts. Respondents in the Milwaukee Area and Chippewa Valley Technical College districts reported the greatest difficulty finding employees to fill open positions; while an average of 67.4% of respondents in the Northcentral Technical College district will need an average of 29 mechanical design career area employees each year through 2010.

In 13 of the 16 Wisconsin technical college districts, machine tool career area employees were greatly needed by respondents. Based on the reported difficulty finding qualified machine tool employees, the average percentage of companies hiring between 2005 and 2010, and the minimum number of employees needed each year, the Milwaukee Area, Gateway, Northeast Wisconsin, Moraine Park, Waukesha County, and Lakeshore Technical College districts had the greatest need for Machine Tool related programs. Data for the Fox Valley, Madison Area, Northcentral, Chippewa Valley, Blackhawk, Western Wisconsin, and Wisconsin Indianhead Technical College districts also indicated that Machine Tool program should be viable in those districts through 2010.

Welding related programs appear to be viable through 2010 in at least 14 of the 16 Wisconsin technical college districts based on data from respondents. The greatest need for welding career area employees was in the Northeast Wisconsin and Gateway Technical College districts. Only in the Southwest Wisconsin and Mid-State Technical College districts was there an insufficient response rate for data to support the determination of whether welding programs were viable in those districts.

Respondents are more confident in their hiring plans in the years 2005 and 2006 than in the years 2007 through 2010. They expect to hire more new and replacement employees in the years 2006 than in the other years studied. However, respondents expect to hire more employees in the years 2005 through 2010 from three of the career areas studied than there are Wisconsin technical college graduates to fill the positions. If the sample size is considered, there will not be enough graduates in any of the four Wisconsin technical college program areas studied to meet the employment needs of

Wisconsin's manufacturers in the year 2005. Current trends based on hiring expectations, the decline in Industrial Technology program graduates, and the fact that half of all respondents cite a skills shortage of applicants for positions tends to indicate there will be a more severe shortage of qualified workers through 2010 in Wisconsin.

Conclusions

The following conclusions address the issues posed by the research questions and are numbered to coincide with each of the seven research questions.

1. The recent decline in Industrial Technology program graduation rates had paralleled the decline in manufacturing employment between 2001 and 2004 to some extent. Throughout the latter half of the 20th century manufacturing employment has tended to decline and rebound; however, the rebounds in employment after each recession have tended to be lower than they were prior to the recession. There is historical evidence that manufacturing employment will continue to decline and that increased technology will result in the need for fewer manufacturing employees with higher levels of skill and education. The four Industrial Technology programs included in this study (Electronics, Mechanical Design, Machine Tool, and Welding) will be needed in the future to supply manufacturers with highly skilled technically literate workers through 2010. Slight declines in enrollments and graduation rates may have been justified, but not the rate of decline that tends to persist.

The Department of Workforce Development classifies some welding and machine tool related careers as those in which employees gain their skill through "on-the-job"

training. This is no longer the primary method in which these employees gain entry to these careers. Increasingly, employers are requiring applicants to obtain one and two year diplomas from vocational and technical education facilities prior to hiring them in these career areas. As the need for employees with the skills required to operate computer controlled equipment increases, Industrial Technology programs in the Wisconsin Technical College System districts that can teach students these skills will be needed acutely.

Respondents in this study cited the need for large numbers of employees each year through 2010 in all four programs studied. The majority of respondents also implied that there is a skilled worker shortage and due to the fact that there are currently not enough WTCS graduates to fill open positions, programs should not be discontinued in the WTCS districts without great efforts to increase enrollments in these programs.

2. There are many factors to consider when trying to select a career and determine academic programming needs based on Wisconsin Department of Workforce Development (DWD) job projections. The first is the classification of the careers and the second is the educational category in which the jobs are placed. Other factors include the methodology used in determining employment trends and the fluctuations in the economy and manufacturing environment each year. To compare the results of this study with DWD projections would require more knowledge about the total population size of the four career areas studied and the many categories of jobs that each of the four career areas could be classified in.

There was sufficient information from this study to determine that respondents believe they will need more employees in mechanical design related jobs than the DWD predictions estimate. If the sample represents only a small portion of the total population of employers that would potentially hire graduates of mechanical design programs from the Wisconsin technical colleges, then the DWD projections do not coincide with the results of this study for the years examined.

3. There will be the need in Wisconsin's technical colleges for all four Industrial Technology programs areas studied through the year 2010 in Wisconsin. Of the programs included in this study, Machine Tool related programs and Welding programs will be needed to the greatest extent by Wisconsin's industrial employers throughout the state of Wisconsin. Respondents that cited the need for machine tool related and welding career area employees tended to need more new employees per company hiring than the respondents that reported the need for electronics and mechanical design career area employees. This is likely to be due to the nature of the work involved in production of goods by precision metal workers and welders as opposed to the design and engineering of products or the repair and upkeep of machinery by mechanical design and electronic technicians.

4. The need for specific programs in each Wisconsin technical college district varied to some extent, which could be expected based on the demographics of the populations. Tables 46 through 61 show the order in which the programs in each district are needed through 2010 based on the survey results. These conclusions are based on the percentage of respondents citing difficulty finding employees in each career area, the average

number of employees needed each year from 2005 through 2010, and the average number of respondents planning to hire each year through 2010. This data can be found in Tables 29 through 31. Where there was uncertainty regarding which program was needed the most, the order was ranked as equal.

The Blackhawk Technical College district needs Welding programs the most, followed by Machine Tool programs. Table 46 shows the ranking of the four programs in the Blackhawk Technical College district based on the results of this study. This district had a relatively small representation of respondents in the study, but the numbers of employees needed in these two programs by respondents alone would be sufficient to justify continuing the Welding and Machine Tool programs. With 55.5% of respondents intending to hire Mechanical Design employees and 43.8% hiring Electronics related employees, there should be more investigation to determine the extent to which these programs are needed in the district. Consideration should also be given to the fact that this study covered only respondents in the state of Wisconsin and this district borders the state of Illinois.

Table 46.

Blackhawk Technical College Program Need-Ranked

	Rank Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Blackhawk	4	3	2	1

In the Chippewa Valley Technical College district, Machine Tool and Mechanical Design programs had the greatest need based on the average number of employees needed through 2010. Welding programs and Electronics programs will also be needed, but the percentage of employers hiring machine tool related career employees was greater along with the number of employees needed and the difficulty with which employers are having finding machine tool employees. There were sufficient numbers of employees needed in both Machine tool and mechanical design careers to justify continuing those programs. Depending on the district requirements for programs, there were also probably enough employees needed in welding and electronics career areas to justify continuing those programs as well. Table 47 shows the programs ranked by need for Chippewa Valley Technical College based on the results of this study.

Table 47.

Chippewa Valley Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Chippewa Valley	3	2	1	3

There are sufficient numbers of employees needed in all four programs studied to justify continuing all of these programs in the Fox Valley Technical College district. The need was greatest for Machine Tool programs with 60.7% of respondents planning to hire an average of 33 employees each year through 2010 in machine tool careers. Respondents who hire employees in the electronics career areas have the most difficulty finding

employees and will need an average of 17 new employees each year. There will be an average of 25 new or replacement welding employees and 18 mechanical design employees needed each year through 2010. Table 48 shows the ranking for programs based on need for the Fox Valley Technical College district.

Table 48.

Fox Valley Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Fox Valley	2	4	1	2

The Gateway Technical College district needs welding employees the most, but respondents that hire machine tool and electronics employees have more difficulty finding qualified workers than those needing mechanical design or welding employees. There were sufficient numbers of employees needed in the welding and machine tool career areas to justify continuing welding and machine tool programs through 2010. There will also probably be enough employees needed in the electronics career areas to justify continuing that program in the Gateway Technical College district. It is unknown whether there will be sufficient numbers of mechanical design employees needed by employers in the district to justify this program without further investigation. Consideration should also be given to the fact that this district borders the state of Illinois and this study only included Wisconsin participants. Table 49 shows the ranking of programs, by need, in the Gateway Technical College district.

Table 49.

Gateway Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Gateway	3	4	1	1

There were only 11 respondents in the Lakeshore Technical College District, however, at least 60% of them reported difficulty finding qualified workers in the electronics, machine tool, and welding career areas. More than two-thirds of the respondents plan to hire workers through 2010 in those three career areas and there are sufficient numbers of employees needed in the welding and machine tool jobs to justify continuing those programs in this district. Table 50 shows the ranking of the programs for the Lakeshore Technical College district.

Table 50.

Lakeshore Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Lakeshore	3	4	1	2

Respondents in the Madison Area Technical College district reported the need for enough employees each year through 2010 to support continuation of all four program areas studied. They reported the most difficulty finding workers in electronics related career areas (65.2%). The electronics career area is also the area in which respondents reported the highest average rate of hiring each year through 2010. This district had 45 respondents, which would tend to lend more credibility to the results than in districts with lower response rates. Table 51 shows the rank of the four program areas in the Madison Area Technical College district based on the average minimum number of employees needed, the average hiring rate, and level of difficulty finding workers in each career area. The programs in the machine tool and welding career areas are needed about equally. Respondents in this area reported the lowest level of difficulty finding mechanical design employees, perhaps due to the close proximity of the University of Madison campus and the availability of graduates from programs in Madison.

Table 51.

Madison Area Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Madison Area	1	4	2	2

The Mid-State Technical College district was not well represented in this study with only 9 respondents. Table 52 shows the ranking of programs in this district based on the average minimum number of employees needed each year through 2010, the average

number of respondents hiring in each career area, and the difficulty with which respondents had finding qualified workers. There were insufficient numbers of employees needed from the study sample to determine if any of the four programs will be needed in the Mid-State Technical College district through 2010. An average of 69.5% of respondents that hire machine tool employees plan to hire each year through 2010, which is the highest level of the four program areas studied.

Table 52.

Mid-State Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Midstate	3	4	1	2

In the Milwaukee Area Technical College district, there were very large numbers of employees needed by respondents in the machine tool career areas and more than three-quarters of respondents plan to hire employees each year through 2010 in machine tool related careers. While Machine Tool programs were needed the most by respondents in this district, programs in Electronics, Mechanical Design, and Welding were also needed and all four programs will be viable through 2010. Table 53 shows the ranking of the four programs in the Milwaukee Area Technical College district based on the need for employees, rate of hiring, and difficulty finding qualified workers as reported by survey respondents. There were 41 respondents in this district and 10 of these represented

companies that hire electronics career area employees. All of the respondents that hire electronics employees (100%) reported difficulty finding qualified workers.

Table 53.

Milwaukee Area Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Milwaukee	1	3	1	4

Table 54 shows the ranking of programs in the Moraine Park Technical College district based on the need reported by survey respondents. The Machine Tool and Welding related programs will be viable in the district through 2010, with the greatest need by respondents for machine tool career area employees. There were 25 respondents in the Moraine Park Technical College district and of those who would hire electronics and mechanical design career area employees there was not enough information to determine whether those programs would be viable through 2010 in the district.

Table 54.

Moraine Park Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Moraine Park	4	3	1	2

The Nicolet Area Technical College district was represented by only two respondents. This district does not have a large number of employers that would potentially hire graduates of some of the programs studied. However, both of these respondents hire employees in the welding career area, have difficulty finding workers, and plan to hire employees each year through 2010. There is the need and justification in the Nicolet Area Technical College district to continue offering welding programs through 2010. It is unlikely that there would be sufficient numbers of employees needed in the district to justify the other programs if employers could fill positions by hiring graduates from other districts. Table 55 shows the ranking of the programs in the Nicolet Area Technical College district based on respondent need for employees, their hiring rate, and the difficulty with which they have finding qualified workers.

Table 55.

Nicolet Area Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Nicolet	2	2	2	1

The Northcentral Technical College district will need all four programs studied through 2010. Table 56 shows the rank of the programs based on the need for them reported by survey respondents. There were 35 respondents in this district and welding employees will be the most sought after followed closely by machine tool and mechanical design career area employees. While electronics career area employees were

not reported to be as highly needed as the other career areas, there was still a sufficient number of job openings each year through 2010 to justify continuing Electronics programs and an average of 62.2% of respondents who hire electronics employees plan to hire each year with more than half reporting difficulty finding qualified workers.

Table 56.

Northcentral Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Northcentral	4	2	2	1

In the Northeast Wisconsin Technical College district, all four program areas studied will be needed very much through the year 2010 to supply district employers with workers to fill open positions. While all programs are needed, Welding programs are needed the most, followed closely by Machine Tool programs. Respondents cite the need for an average of nearly 40 employees each year through 2010 in both of these career areas. Table 57 shows the ranking of the programs in the Northeast Wisconsin Technical College district based on the minimum number of employees needed by respondents, the difficulty with which they have difficulty finding qualified workers, and the average percentage of respondents planning to hire each year through 2010. The Electronics and Mechanical Design programs are needed about equally, and while ranked third, there will still be sufficient numbers of employees needed in this district to justify continuing these programs.

Table 57.

Northeast Wisconsin Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Northeast	3	3	2	1

The Southwest Technical College district had only 9 respondents and does not have as large a manufacturing base as most of the other districts. There were no career areas in which there were sufficient numbers of employees needed each year through 2010 to state whether any of the four programs will be needed in this district. Although there were not large numbers of employees reported as needed, the programs are still ranked by order of need in Table 58. Fewer than half of the respondents intend to hire each year through 2010 in any of the program areas studied; however, the most need for employees was reported in welding career areas. Respondents that hire machine tool employees reported the greatest difficulty finding qualified workers (75%) and 66.7% had difficulty finding electronics career area employees. No respondents from this district reported the need for any mechanical design employees through 2010.

Table 58.

Southwest Wisconsin Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Southwest	3	4	2	1

Table 59 shows the program ranking for the Waukesha County Technical College district based survey respondent's average yearly employee need, difficulty finding qualified workers, and average number of respondents hiring each year through 2010. There were 27 respondents, but only in the machine tool career area was it clear from the results that this program would be needed through the year 2010 based on the average number of employees needed each year. However, more than half of the respondents plan to hire each year through 2010 in the electronics and machine tool career areas and more than 45% plan to hire mechanical designers and welders.

Table 59.

Waukesha County Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Waukesha	3	3	1	2

The greatest need for employees in the Western Wisconsin Technical College district through the year 2010 will be for welding and machine tool related career areas. These two programs will be viable in the Western Wisconsin Technical College district through 2010. Respondents expect to hire a minimum of 17 welders and 15 machine tool employees each year through 2010 in this district. Table 60 shows the program ranking based on the average minimum number of employees needed each year, the difficulty with which they reported difficulty finding qualified employees, and the average percent of respondents hiring each year through 2010. There were 27 respondents in the Western

Wisconsin Technical College district and of those that hire electronics and mechanical design employees just over two-thirds had difficulty finding workers in those career areas. Based on the results of this study, it is unknown to what extent these two programs will be needed in the future in this district. However, this study included only respondents from the state of Wisconsin and this district shares the border with Minnesota and the need for employees may be greater than the survey results indicate.

Table 60.

Western Wisconsin Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Western Wisconsin	3	4	2	1

Table 61 shows the ranking of programs in the Wisconsin Indianhead Technical College district based on the minimum number of employees needed each year by respondents, the difficulty with which they have finding qualified workers, and the average number of respondents expecting to hire each year through 2010. The programs that will be viable through 2010 in this district are the Machine Tool and Welding programs. Respondents cited the need for a minimum of 33 machine tool and 25 welding career area employees each year through 2010 in the Wisconsin Indianhead Technical College district. There was less need for employees by respondents that hire electronics and mechanical design employees, however, nearly half of respondents plan to hire mechanical design employees and 60% plan to hire electronics career area employees.

This district shares the border with Minnesota and this study only included respondents in the state of Wisconsin.

Table 61.

Wisconsin Indianhead Technical College Program Need-Ranked

	Order Programs Most Needed			
District	Elec.	Mech. Design	Mach. Tool	Weld
Wisconsin Indianhead	3	3	1	2

5. With more than half of all respondents that hire Electronics, Machine Tool, and Welding program graduates and over 40% who hire Mechanical Design graduates stating that they have had difficulty finding qualified workers in the 2004-2005 time period, there is a shortage of skilled workers available to Wisconsin employers. Statewide, the main reason for the lack of availability of qualified workers is that applicants for open positions lack the skills required for the jobs. There also was a problem in many areas with applicants not wanting to work the hours or shift that the job requires and as employers continue to try to be competitive by operating two or three shifts, this trend could increase in the future.

There were many respondents that required more prior work experience from applicants with 30.4% citing this as a factor that has affected their hiring. The Gateway Technical College district was remarkable with over 45% of survey respondents finding applicants lacking prior work experience and 68% stating that job applicants lacked the

required skills for the position. The technical colleges may be able to help area employers by requiring internships in programs in which employers would like applicants to have work experience.

The Lakeshore Technical College district was unusual in that it had the largest percentage of respondents, next to Nicolet, citing that there were no applicants for open positions (54.4%), had the highest percentage of respondents that stated that applicants for positions lacked required credentialing (45.5%), and was above the state respondent average for job applicants that lacked required skills (54.5%) and lacked work experience (36.4%). The lack of applicants for open positions was most apparent in the electronics career areas and the lack of credentialing was cited most frequently by respondents that hire mechanical design and machine tool program graduates.

In every Wisconsin Technical College System district there were respondents that cited difficulty finding qualified workers for positions, cited a lack of applicants for positions, reported that applicants lacked required skills, and that applicants did not have the work experience required for open positions. Additionally, all but one district stated that applicants lacked credentials and that they had trouble finding workers that wanted to work the shifts required. There are three problem areas identified with the skilled worker shortage. There is not a large enough pool of applicants for positions, there are issues with workers electing not to work in jobs in which they don't want to work the hours required, and there are problems with lack of training, experience, and credentialing. If the technical colleges increased the number of graduates in the programs so that there were more applicants than positions needed by employers, they would have more applicants to choose from and may have a higher quality workforce.

The results of this study concur with Dr. Beth Buehlmann's testimony presented to the United States House of Representative's Committee on Education and the Workforce (2003). In that testimony, Dr. Buehlmann cited a survey conducted in 2003 that stated that about 50% of employers could not find workers with the right skills. While there are predictions of acute worker shortages in Wisconsin after the year 2010 due to the expected retirements of large numbers of the Baby Boomer generation, this study tends to indicate that there is already a skilled worker shortage that will be in evidence through 2010 and that it will become much worse after 2010.

In reports released by the National Association of Manufacturer's (2001) and the Employment Policy Foundation (2001), the inability of manufacturers to meet production demands will prevent manufacturers from competing globally and could cause them to stop producing goods entirely. Respondents to this survey commented freely and there were many pleas for help from the researcher. One respondent stated that their company had turned down over one million dollars in contracts because they could not find enough machinists and welders. The respondent stated that their company would hire 30 workers immediately if they could only find them. Another respondent drew a chart on the survey detailing the future as older generations retire and leave the workforce without sufficient younger workers to replace them.

With regards to forestalling a skilled worker shortage in the future, the future is now and immediate action is required. Solutions suggested by the Employment Policy Foundation included increasing the labor force participation rate, increasing immigration, and increasing the productivity level of workers (2001). Targeted marketing of careers, media support, a concerted effort by stakeholders, and increased grant dollars to improve

and upgrade industrial technology programs, such as occurred to increase program enrollments in nursing programs, is what will be required to help prevent more acute shortages of skilled industrial workers in the future.

Productivity can only be improved and increased by teaching workers on the most modern equipment available. Technical colleges typically do not have budget capital to upgrade equipment and often rely on donated, out of date equipment to teach the future workforce.

6. It is apparent that industrial employers will need large numbers of graduates of Machine Tool and Welding programs in the years 2005 and 2006. Moderate numbers of graduates from Electronics related and Mechanical Design programs will be needed by industrial employers in 2005 and 2006, with larger numbers of employees needed in some geographic locations in Wisconsin.

7. The perception of survey respondents for graduates of the four programs studied between 2006 and 2010 varies by program and year. For the year 2006, respondents have the greatest confidence in their need for employees in all four program areas. For the years 2007 through 2010, the confidence of respondents for the need for employees declines slightly each year, while the number of respondents who do not know the number of employees they need, or whether they will need employees, tends to increase slightly each year. The percentage of respondents that are confident that they will not be hiring new or replacement employees in the years 2007 through 2010 does not increase and tends to decrease in those years for most of the career areas studied.

Based on the minimum number of employees needed by respondents between the years 2006 and 2010, all four industrial technology programs will be needed in the state of Wisconsin through the year 2010 to supply industrial employers with employees in the career areas studied. The need for employees through 2010 will be greatest in the machine tool and welding career areas. Employees in electronics and mechanical design technology careers will be needed, though not as acutely as machine tool and welding workers.

There will be an acute need for employees in all four career areas studied if enrollments are not increased in Electronics related, Mechanical Design, Machine Tool related, and Welding related programs in the Wisconsin Technical College System districts where the need for employees is the greatest.

Recommendations

This section will suggest recommendations related to the study and for further research based on the findings of the study and the review of literature.

Recommendations for WTCS District Administrators

While this study indicates that there is the need for all four programs studied, there is the history and trend in manufacturing toward increased productivity through automation and a decline in the workforce needed to produce goods. The districts that decide to continue offering programs in industrial technologies must concentrate resources on upgrading and maintaining one modern program for each career area in each district and not offer two or three substandard programs in more than one campus

location in each district unless district budgets are sufficient to maintain modern programs. High quality education must take precedence over quantity. With many Wisconsin technical colleges facing budget constraints, financial resources should be focused carefully.

Marketing and enrollments in the programs studied will continue to be an issue in the future and it would be a mistake to try to remedy the skilled worker shortage by increasing the numbers of programs or maintaining programs in areas that cannot support enrollment goals. Maintaining programs in districts where there is little likelihood of increasing enrollments will result in lower enrollments in more viable areas and districts.

This study indicated that there is the need for graduates of all four of the programs studied. Counselors in the Wisconsin Technical College System districts should be made aware of the results of this study so that they may inform prospective students of the opportunities in the Electronics, Mechanical Design, Machine Tool, and Welding career areas.

Marketing plans should be designed to target specific populations to promote Machine Tool, Welding, Electronics, and Mechanical Design programs as needed for each district.

Recommendations for Secondary and Post Secondary Education Counselors

There is the perception that there is little future for workers in manufacturing careers and that these jobs are dirty and low tech. There will be a desperate need for graduates of programs related to electronics, electromechanical technology, mechanical design, machine tool, tool and die, computer numerical control programmers and

operators, and welding in the future. There currently is a shortage of workers in these fields and it will become very acute in the future if enrollments are not increased. The job prospects for graduates of these programs should be good to excellent in the future, as predicted by the Occupational Outlook Handbook. Manufacturing jobs tend to be well paying and usually have very good benefits. Counselors should visit the technical colleges and tour the program areas studied to learn more about what opportunities are available and what employees in each of these career areas do on a day to day basis.

It is imperative that counselors promote these programs as viable career choices for prospective students. Counselors should review the results of this study to determine which career area technical college graduates are needed the most in for the district in which they reside. The career areas that have the most need for employees in each district should be the programs that are promoted with the highest priority.

Recommendations for Individual Wisconsin Technical College System Districts

Each Wisconsin Technical College System district should review the results of this study and where there is a clearly determined deficit for specific program graduates to meet the need of district employers marketing plans should be developed and implemented to promote those programs.

The results of this study should be disseminated to career counselors, high school counselors, advisors, and local workforce counseling personnel to help raise their awareness of the career opportunities in manufacturing companies.

Recommendations Related to this Study

The survey used for this study should have had survey item 4 changed so that the order of programs was consistent with the order of subsequent survey items. For this item, Mechanical Design should have preceded Machine Tool for the response choices.

A Likert scale survey item should have been included that asked respondents how difficult they believed it would be to find employees in each of the career fields studied in the future.

Recommendations for Further Study

Each Wisconsin Technical College System district should conduct in depth surveys of area employers to help determine the need for employees in the future. Advisory committee meetings and focus groups often have low turnout, selective representation, and do not tend to give results that are as candid as confidential surveys. Whenever possible, surveys should be sent to the entire population of employers for each career area in each district.

This study should be repeated to help determine if respondent needs have changed, the study results are consistent, and if it can be improved upon.

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Appendix A: Cover Letter

February 10, 2005

Dear Company Owner or Representative:

I am writing to request your participation in a survey to help determine the need for graduates of several programs in the Wisconsin Technical College Districts. These programs are:

- Electronics related programs (such as electromechanical technology, biomedical electronics, electronic servicing technician, and electronics, or similar)
- Machine Tool related programs (jobs would include machinists, tool & die makers, CNC programmers/operators, moldmakers, and die makers, or similar)
- Mechanical Design related programs (job titles would include mechanical design technicians, mechanical drafters, engineering assistants, and drafting technicians)
- Welding related programs (jobs would include fabrication welders, industrial welding technicians, steam fitters, and welders)

As a graduate student at UW-Stout, a journeyman tool & die maker, and an instructor at Western Wisconsin Technical College, this research topic is of particular interest to me and of importance to you as a potential employer of graduates of the programs being studied.

The survey is designed to be completed in 15- 20 minutes. Please return the completed survey in the enclosed addressed and postage paid envelope at your earliest convenience and no later than March 11, 2005. If someone other than you would be more suited to answer the questions on this survey, please forward the survey to that person.

Your participation in this research is entirely voluntary, but I hope you will help me with my research by participating. If you choose not to participate, please indicate this on the survey and return it in the enclosed envelope. All responses will remain confidential and no respondent will be identifiable when the results are published. Any questions or concerns about participation in the research or subsequent complaints should be addressed first to me or the research advisor, Dr. Howard Lee, 225A Applied Arts Bldg., UW-Stout, Menomonie, WI 54751, phone (715) 232-1251; and second to Sue Foxwell, Administrator, UW-Stout Institutional Review Board for the Protection of Human Subjects in Research, 152 Vocational Rehabilitation Bldg., UW-Stout, Menomonie, WI 54751, phone (715) 232-2477.

Thank you very much for your help!

Sincerely,

Patricia A. Due-Detroyer
UW-Stout Graduate Student
Career and Technical Education
(608) 785-9245 or due-detroyerp@uwstout.edu

Appendix B: Survey

Consent to Participate In UW-Stout Approved Research

Title: Wisconsin Industrial Employer's Perceptions of the Need for Graduates of Specific Industrial Technology Programs in the Wisconsin Technical College Districts

Investigator:
Patricia Due-Detroyer
608-785-9245
Western Wisconsin Technical College
La Crosse, WI 54602

Research Advisor:
Dr. Howard Lee
715-232-1251
225A Applied Arts Bldg
UW-Stout
Menomonie, WI 54751

Description: This survey is being conducted to help determine the extent to which employers in Wisconsin need Wisconsin Technical College graduates of Electronics related programs, Mechanical design programs, Machine tool related programs, and Welding programs in each of the 16 technical college districts through the year 2010.

Risks and Benefits: The risks associated with participation in this survey are expected to be minimal. There are no identified or known risks to your participation in this survey. Your participation in this survey can help the technical colleges determine the need for programming and the need to conduct future studies to determine more specific needs of employers in Wisconsin. Where there is evidence to support continuance of technical college programs with low enrollments, further marketing campaigns can be employed by the college districts.

Time Commitment: Your time is valuable and I tried to keep this survey as short as possible. It is estimated that completing this survey will take approximately 15 to 20 minutes.

Confidentiality: Any identifying information will remain confidential. No personal information is required and the zip code of your company's location is only needed for determining the technical college district where your company is located. Research conducted by UW-Stout is required to remain confidential.

Right to Withdraw: Your participation in this study is entirely voluntary. You may choose not to participate without any adverse consequences to you. Should you choose to participate and later wish to withdraw from the study, contact the research investigator, Patricia Due-Detroyer.

IRB Approval: This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study please contact the Investigator or Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.

Investigator:
Patricia Due-Detroyer
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due-detroyerp@uwstout.edu

Advisor:
Dr. Howard Lee,
715-232-1251
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IRB Administrator
Sue Foxwell, Director, Research Services
152 Vocational Rehabilitation Bldg.
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715-232-2477
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This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Employer Survey

Purpose of the Survey:
This survey is to determine to what extent industrial employers need graduates of specific industrial technology division programs in each of Wisconsin's 16 technical college districts through the year 2010.

Survey Instructions:
Please read and answer all questions that apply to your company's employment needs. This study is important to the technical college districts to help understand the current and future need for programs in the Trade and Industry divisions of the Technical College System. The location of your company is important to the researcher to determine the technical college districts where program graduates are needed. If you have any questions or comments, please contact Pat Due-Detroyer at (608)785-9245 or by e-mail at due-detroyerp@uwstout.edu.

1. Zip code of company location: _____

2. How many employees are employed by your company? (Please check only one.)

   ☐ 10 or less employees
   ☐ 11 to 50 employees
   ☐ 51 to 100 employees
   ☐ 101 to 250 employees
   ☐ 251 to 500 employees
   ☐ 501 or more employees

3. Have you hired graduates of Wisconsin's technical colleges in the past?

   ☐ Yes
   ☐ No

4. Have you in the past, or would you potentially hire graduates of the following program areas? (Please check all that apply.)

   ☐ Electronics related programs (including electronics, electronic servicing, electromechanical technology, biomedical electronics, and/or electronic servicing technician)
   ☐ Machine tool related programs (including machinists, tool & die makers, mold makers, die makers, toolmakers, CNC programmers/operators, CNC technicians, and/or related machine tool trades)
   ☐ Mechanical Design technology program (including mechanical design technicians, mechanical drafters, engineering assistants, drafting technician, and/or other job classifications related to mechanical design)
   ☐ Welding related programs (including fabrication welders, industrial welding technicians, steam fitters, and welders)

5. If you have hired graduates of the programs listed in question #4 in the past, approximately how long ago did you hire graduates?
   (Please check all that apply.)

- ☐ Within the past year
- ☐ 2 to 5 years ago
- ☐ 6 to 10 years ago
- ☐ More than 11 years ago

6. In the past year, has your company had difficulty finding qualified workers to fill positions in any of the following career areas?
(Answer all career areas that apply.)

Electronics related:
- ☐ Yes
- ☐ No

Mechanical design related:
- ☐ Yes
- ☐ No

Machine tool related:
- ☐ Yes
- ☐ No

Welding related:
- ☐ Yes
- ☐ No

If you answered "Yes" to any items in question 6, please answer questions 7 and 8.

7. What do you believe are the reasons you have had difficulty finding qualified workers?
(Please check all that apply.)
   - ☐ No applicants for the position
   - ☐ Applicants did not have degree or credentialing required for the position
   - ☐ Applicants did not have the skills required for the position
   - ☐ Applicants did not have the prior work experience required for the position
   - ☐ Applicants did not want to work the shift or hours required for the position
   - ☐ Technology changes that require employees with higher levels of skills than those of technical college graduates who have applied
   - ☐ Other _____-
     _____

8. In which job area do you find it the most difficult to find technical college graduates to fill positions?
(Please select only one.)
   - ☐ Electronics related
   - ☐ Mechanical design related
   - ☐ Machine tool related
   - ☐ Welding related

9. What other factors have affected hiring practices of your company in the past year?
(Please check all that apply.)
   - ☐ Slowdown of economy
   - ☐ Lack of orders or work
   - ☐ Technology changes that require fewer employees
   - ☐ More in-house training is required rather than training from external sources
   - ☐ Lack of funds

☐ Changes in job classifications (reconfiguration)
☐ Other

_____

10. Do you anticipate hiring new employees as the result of company growth in the next year (through 2005)?

☐ Yes
☐ No

11. Do you anticipate replacing employees in the next year due to retirements or for other reasons unrelated to company growth?

☐ Yes
☐ No

12. If you anticipate hiring new employees or replacing employees in the next year (2005), please estimate the number of new employees needed for each of the following applicable career areas: (Please rate each career area that applies to your company, but check only one box for each career area.)

Electronics related:
☐ 1 to 3 employees
☐ 4 to 6 employees
☐ 7 or more employees
☐ Number unknown

Mechanical design related:
☐ 1 to 3 employees
☐ 4 to 6 employees
☐ 7 or more employees
☐ Number unknown

Machine tool related:
☐ 1 to 3 employees
☐ 4 to 6 employees
☐ 7 or more employees
☐ Number unknown

Welding related:
☐ 1 to 3 employees
☐ 4 to 6 employees
☐ 7 or more employees
☐ Number unknown

13. While the future economic climate is unknown, please give your perception of your company's annual need for employees in each of the following career areas for the years 2006 through 2010. Please answer as best you can.

Year 2006			
Electronics related: ☐ 0 employees	Mechanical design related:	Machine tool related: ☐ 0 employees	Welding related: ☐ 0 employees

☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown
Year 2007			
Electronics related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Mechanical design related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Machine tool related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Welding related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown
Year 2008			
Electronics related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Mechanical design related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Machine tool related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Welding related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown
Year 2009			
Electronics related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Mechanical design related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Machine tool related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Welding related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown
Year 2010			
Electronics related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Mechanical design related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Machine tool related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown	Welding related: ☐ 0 employees ☐ 1 to 3 employees ☐ 4 to 6 employees ☐ 7 or more employees ☐ Number unknown

Thank you for participating in this survey!

Consent Statement:

I understand that by returning this survey, I am giving my informed consent as a participating volunteer in this study. I understand that the purpose of the study is to help determine the need for specific technical college graduates and agree that any potential risks are exceedingly small. I also understand the potential benefits that might be realized from the successful completion of this study. I am aware that any information collected during this study will remain confidential and confidentiality is guaranteed. I realize that I have the right to refuse to participate and that my right to withdraw from participation at any time during the study will be respected with no coercion or prejudice.

Questions or concerns about participation in the research or subsequent complaints should be addressed first to the researcher, Patricia Due-Detroyer, or to the research adviser, Dr. Howard Lee; and second to Sue Foxwell, Administrator, UW-Stout Institutional Review Board for the Protection of Human Subjects in Research, 152 Vocational Rehabilitation Bldg., UW-Stout, Menomonie, WI, 54751, phone (715) 232-2477.

Appendix C: Survey Reminder Post Card

Dear Company Owner or Representative,

I recently sent a survey to your company designed to help determine the need for graduates of several Industrial Technology programs in Wisconsin's Technical College System, which is part of my graduate research at UW-Stout.

The results of the survey may be used by school counselors and administrators, and to determine marketing needs of programs. We hope to have the results availably in July 2005. **If you would like a copy of the results**, please contact me via e-mail: due-detroyerp@uwstout.edu Alternatively, results should be available through the NWMOC and WMEP.

If you have already returned your survey, I appreciate your participation very much. **If you have not returned your survey and would still like to participate, please send it back soon.** Over 1,600 surveys were mailed to employers in Wisconsin and participants are assured confidentiality. If you need a replacement survey, please contact me at due-detroyerp@uwstout.edu or the return address on this card, and I will send one.

Thank You,

Patricia A. Due-Detroyer

Appendix D: Additional Tables

Table D1.

Percent of Companies Responding To Factors Affecting Hiring—By District

District	No Applicants	Lack Credentials	Lack Skills Required	Lack Required Experience	Don't Want to Work Shift	Tech Changes Require Higher Skills	Other
Blackhawk	7.7	15.4	38.5	15.4	30.8	7.7	7.7
Chippewa Valley	20.0	8.0	36.0	24.0	12.0	0	4.0
Fox Valley	26.5	23.5	50.0	23.5	17.6	5.9	2.9
Gateway	22.7	18.2	68.2	45.5	22.7	13.6	13.6
Lakeshore	54.4	45.5	54.5	36.4	18.2	0	0
Madison Area	13.3	22.2	37.8	33.3	15.6	0	11.1
Midstate	22.2	44.4	66.7	11.1	22.2	0	11.1
Milwaukee	9.8	19.5	58.5	39.0	22.0	9.8	0
Moraine Park	16.0	12.0	60.0	32.0	36.0	0	8.0
Nicolet	100.0	50.0	100.0	50.0	0	50.0	0
North Central	14.3	17.1	51.4	37.1	20.0	2.9	14.3
Northeast	18.8	25.0	50.0	25.0	18.8	3.1	3.1
Southwest	44.4	0	11.1	11.1	11.1	0	0
Waukesha	18.5	18.5	59.3	29.6	14.8	7.4	7.4
Western Wisconsin	11.1	18.5	51.9	29.6	14.8	0	7.4
Wisconsin Indianhead	13.3	33.3	53.3	30.0	13.3	6.7	6.7

Table D2.

Respondent Comments to Survey Item Seven "Other"

Comments by Respondents
- About 50% failed basic math test
- Local tech college eliminated program
- Only a few apply. Applicants didn't like the wages
- Many seem to job hop
- Previous union affiliation-skill level low.
- Poor driving records
- Did not participate in state employment exam process
- don't want to work in a manufacturing environment
- Workers need very good electronics & mechanical background (both)
- Field service workers require training plus self confidence
- Number of applicants
- Applicants were not a complete match to what we were looking for.
- Unwillingness to relocate to Wisconsin area
- Unrealistic expectations of the applicant
- Low quality with poor prior work history
- Lack of basic work ethics and job skills
- For CAD Drafters-No structural steel training
- Not enough applicants in machine tool field to fill the needs of our areas employers.
- Lack of wanting to travel
- Poor history of work stability
- Pool of applicants getting smaller and smaller
- Pay scale compared to large cities
- Not enough students in Mfg related programs in the tech colleges

Table D3.

Percent of Companies Responding To Other Factors that have Affected Hiring Practices—By District

District	Slowdown of Economy	Lack of Orders/Work	Tech Changes-Fewer Workers	More in-house Training	Lack of Funds	Reconfiguration	Other Factors
Blackhawk	23.1	15.4	23.1	23.1	7.7	7.7	23.1
Chippewa Valley	16.0	16.0	8.0	16.0	16.0	4.0	24.0
Fox Valley	50.0	20.6	17.6	23.5	5.9	8.8	5.9
Gateway	36.4	45.5	40.9	9.1	9.1	9.1	9.1
Lakeshore	18.2	36.4	18.2	18.2	9.1	9.1	9.1
Madison Area	31.1	22.2	13.3	20.0	0	0	17.8
Midstate	11.1	11.1	22.2	33.3	22.2	0	11.1
Milwaukee	36.6	48.8	17.1	19.5	9.8	7.3	9.8
Moraine Park	40.0	44.0	20.0	20.0	8.0	16.0	12.0
Nicolet	50.0	50.0	0	50.0	50.0	0	0
North Central	37.1	34.3	11.4	34.3	14.3	14.3	11.4
Northeast	40.6	31.3	18.8	12.5	15.6	6.3	21.9
Southwest	44.4	33.3	11.1	22.2	11.1	22.2	0
Waukesha	48.1	40.7	11.1	7.4	11.1	3.7	14.8
Western Wisconsin	48.1	29.6	22.2	25.9	18.5	7.4	18.5
Wisconsin Indianhead	40.0	40.0	3.3	26.7	13.3	0	13.3

Table D4.

Respondent Comments to Survey Item Nine "Other"

Comment Category	Comments
China-Global Factors	- Business moving overseas - China--exact copy of our product - China getting our work! - Global Market - Outsourcing increased - Foreign competition & the need to turn out new products cheap & fast
Increased Business Factors	- Business is up dramatically--we need skilled help- - Strong business growth w excellent candidate pools to choose from. - Increase in workload - Speed up of the economy - Increase in business - Extremely busy: we are currently having no problems - Extreme growth - We have actually been growing & have not had any difficulty finding good people - Economy was great; orders were plentiful (you must have been reading the liberal media) - More business
Worker Skill Issues	- No qualified workers available - Lack of workers with basic skills - Find quality workers-experience in machine set-up & operation and experienced welders - Structural drafting with architectural quality is not taught--is WI too manuf. oriented in this regard? - Lack of qualified candidates! - Very few machine tool applicants

Worker Ethic and Other Issues	-Positive pre-employment drug tests - Positive pre-employment drug tests - Despite excellent benefit program, they do not stay--they seem to want a 'position', not a job. - Applicants do not want to work nights or weekends - Applicants expect way too much money with NO experience. Piece of paper buys so much ONLY. Experience pays more.
Technology – need skilled workers	- Technology changes that require more trained employees to keep the automation running
Null	- None - Not much - No Need - None - No problem - None - N/A We are always hiring - We have not needed to add any employees