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Identifying the Need for Trained Machinists in the Greater Tri-cities Area: A Survey of Employers to Evaluate the Future of Machining

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ABSTRACT

Machinists are skilled tradespeople responsible for running a variety of machine tools to produce precision components for end-users or for use in other manufacturing. This project identifies the current and future change in the number of machinists in Northeast Tennessee region, especially the five-county service area of Northeast State Community College (NSCC). There is a noticeable upward trend in the number of companies that contact the NSCC looking for machining students to fill open positions at their companies. However, according to the Bureau of Labor Statistic information for Machinist and Tool and Die Makers (these two job titles are listed together), the job outlook is only 1% expected growth from 2016 to 2026. This leaves us wondering if there is more potential growth in our immediate area than predicted by the Bureau of Labor Statistics, or if another phenomenon is occurring. Using an industry survey, the need for machinists is identified and evaluated to understand the state of this critical job in our service area. The results indicate that the local industry needs more machinists to keep up with current demand, as 6 out of 14 companies reported they currently have open positions. Companies also reported an average of 9 open positions for the lowest skill bracket, 9 positions for mid-level machinist, and 12 for the highest skill level. This is about 9.6% of all the machinists in the survey. The positions that companies are struggling to find qualified candidates, may stay open for long periods of time. Furthermore, most companies have an average 15% of their current machinists eligible to retire, reinforcing the result that companies need more machinists.

INTRODUCTION

The career of a machinist gives someone the opportunity to create, by utilizing machines to machine precision parts to make manufacturing possible. While this career is rewarding for those who pursue it, the current skills gap is creating an unfilled need for machinists. Local employers are starting to struggle to find enough employees to fill all their open positions and are worried about being able to fill future openings, a common concern for manufacturers across the nation [1]. There has also been an increase in programs and media promoting technical trades

and describing the current skills gap between the jobs that will be available versus the skilled workers available [2].

Northeast State Community College (NSCC) is a public community college based in Blountville, Tennessee. It offers technical education and degrees in more than 130 programs of study, which can be transferred to a number of local and regional four-year colleges and universities. In recent years, the Machine Tool program has noticed an increase in companies contacting the program for help to find new employees, indicating there is a strong need for new machinists in this area. However, according to the Bureau of Labor Statistics information for Machinist and Tool and Die Makers (these two job titles are listed together), the job outlook is only 1% expected growth from 2016 to 2026 [3]. This still leaves the question, is there more potential growth in our immediate area than predicted by the Bureau of Labor Statistics, or is another phenomenon occurring? Are only the few companies that need new machinists reaching out to the program, while the rest are as stagnant as that 1% growth would indicate? Any attempts to research an answer to this question, generally show one of two results. Either the information is geographically broad covering the nation or entire state, or the information covers a multitude of job titles all grouped into one data set. Many of these sources fall into both categories and only represent a need for technical trades in the USA. This general information still doesn't explain the need for machinists in the Tri-Cities and surrounding service area of NSCC. While some of these reports show positive trends for the future, the broad data set just is not applicable to the small geographic area that NSCC serves. Therefore, the main objective of this study is to identify machinist job prospect in the service area of NSCC. Specifically, this study attempts to answer following questions:

- Are local companies that employ machinists growing as a business?
- Do these local businesses need more machinists?
- If companies need machinists, are they successful in finding good employees?
- Since significant percent of high skilled machinists are considerably older, how will retirement of this generation impact businesses and future employment in our region?

MANUFACTURING INDUSTRY OUTLOOK IN THE USA

Since 2001, Deloitte and The Manufacturing Institute have published multiple reports on the skills gap and how it affects manufacturing in America [4]. These reports show a significant

need for new employees to enter the manufacturing sector. The search for skilled talent—ranked as the No. 1 driver of manufacturing competitiveness by global manufacturing executives—appears to be at a critical level. In fact, Deloitte and The Manufacturing Institute research reveals an unprecedented majority (89%) of executives agree there is a talent shortage in the US manufacturing sector, 5% higher than 2015 results [2]. The Manufacturing Institute expects the number of new jobs in manufacturing to accelerate and grow by 1.96 million workers by 2028; however more than half of the open jobs in 2028 (2.4 million) could remain unfilled because of skill gaps. The report identified two specific examples of the type of technologies that are creating challenges for new employees; the need to program CNC machines, and the ability to interact with CAD/CAM software. Both tasks are almost exclusively machinist related skills used for more automated manufacturing processes.

The quarterly outlook survey by National Association of Manufacturers listed "attracting and retaining qualified workers" as the biggest challenge facing the largest percentage of companies [1]. This challenge was only unseated after the beginning of the COVID-19 pandemic early in the second quarter of 2020 but remained a major concern. During the previous 10 quarters, as many as 70% of responding companies listed finding skilled workers as their biggest challenge. Weber (2016) described "One of the greatest challenges that manufacturers must address now is to convince a new generation of workers to make the same career choice they made a generation ago." The major theme of this article is a focus on new and diverse training to help current and future employees find the skills they need to satisfy the demands of modern manufacturing. The author lists three techniques; make training mobile, make training easy to digest, and teach skills that cannot be found elsewhere. Using these three approaches, the article describes benefits that will help to narrow the skills gap and make workers more effective in their positions.

According to the Bureau of Labor Statistics (BLS), there were 9,460 machinists employed in the state of Tennessee, earning a mean salary of $44,410 in 2019. In comparison, BLS data from May 2018 showed only 7,690 machinists in the state of Tennessee. Therefore, there was an increase of 23% in machinists for the state overall. Based on the May 2019 data, an average of 3.15 out of every 1,000 workers in the state were working as machinists. In comparison, the highest employment of machinists per 1,000 is in Indiana at 6.39 and the lowest is Hawaii with 0.44. Of the states neighboring northeast Tennessee, Virginia has 1.99 machinists per 1,000

employed persons, and North Carolina has 2.67. Each of these numbers covers the entire state regardless of distribution in the state.

The location quotient defines how reflective an area's economy is of the nation as a whole. A labor quotient of less than 1.0 would indicate a region has less of a specific job than the national average, while a quotient of greater than 1.0 would indicate the area has more than the average. For the state of Tennessee, the labor quotient is 1.2 for machinists. This value indicates that Tennessee has a higher-than-average concentration of machinists when compared to the United States as a whole.

RESEARCH METHODOLOGY

Research Context

A survey was created with the goal of determining the employer's current and future needs for machinist in the Northeast Tennessee region. The primary focus of the survey is the current state of the company's business, their current needs for new employees, and the timeline for hiring new individuals. Unfortunately, the manufacturing sector in general is somewhat unpredictable, so questions that would ask the companies to predict the future of their companies were avoided. Instead, an accurate measure of the current status of the industry, in comparison to past national studies, should give an indication of future trends.

Participants

The 2016 Directory of manufacturers published by the First Tennessee Development District in Johnson City was used to identify companies for the survey [5]. The initial list of companies was defined by the following criteria:

- More than five employees, as listed in the directory
- Five counties served by NSCC; Sullivan, Washington, Unicoi, Johnson, and Carter.
- Business related to, or directly involving machining, especially any company identified by the NAICS code 332710 as a machine shop.

While many of the companies on the list utilized the code for being a machine shop, others are primarily focus on producing other products and machining supports this manufacturing. Knowing very small businesses could generate less consistent data, they were eliminated from the survey pool. Some of the very small machine shops may not have any turnover for many years, especially when the employees are family as well. Once the companies were identified,

the survey was sent to each company by email, either through a known contact or to the human resources department. In a few cases, phone calls were made to identify the best person to contact, or to follow-up with companies that did not respond to the initial email.

Instrument and Measures

The survey consists of a total of 12 questions targeted towards different areas of the company and their needs. The initial questions work to define the company and ascertain the number of employees and their salaries. Next, the survey works to define the needs of the company, specifically their need for employees and how they are going about finding those future employees. The last section of the survey hopes to determine the future needs of the company based on how the company is growing and the number of current employees who are eligible to retire. A complete copy of the survey, as sent to employers is included in Appendix A.

SURVEY RESULTS AND DISCUSSION

The survey was sent to thirty companies within the five-county service area of NSCC. East Tennessee State University's RedCap Software was utilized to distribute and collect responses for the survey. A total of 14 responses were received with a response rate of 47%. Unfortunately, during the process of collecting the data from the survey, the American economy faced an unprecedented challenge, as the COVID-19 pandemic forced the nation into quarantine. The pandemic changed the American economy drastically and suddenly at every level. While most of the manufacturing companies were considered essential and continued working, the pandemic still affected them, especially their supply chains. Due to the pandemic, it became very hard to get in touch with the companies who had not completed the survey. Many of the companies were just too overwhelmed with adapting to the changes mandated due to COVID-19, and completing the survey was not their priority.

The companies that responded to the survey covered a wide cross section of employers, with total employee counts as low as 10 to as high as almost 7,000 employees. Among them, the companies designated 2 to 140 as machinist (Figure 1) and total number of machinists in the surveyed companies was 313. Each of these companies represents a unique part of the market, with some being primarily "job shops" that take in outside work, to companies focused on machining products they then sell directly to individual end users. Some of the shops, however,

are only doing maintenance work to support a larger operation, while others are a link in the manufacturing chain of complex systems.

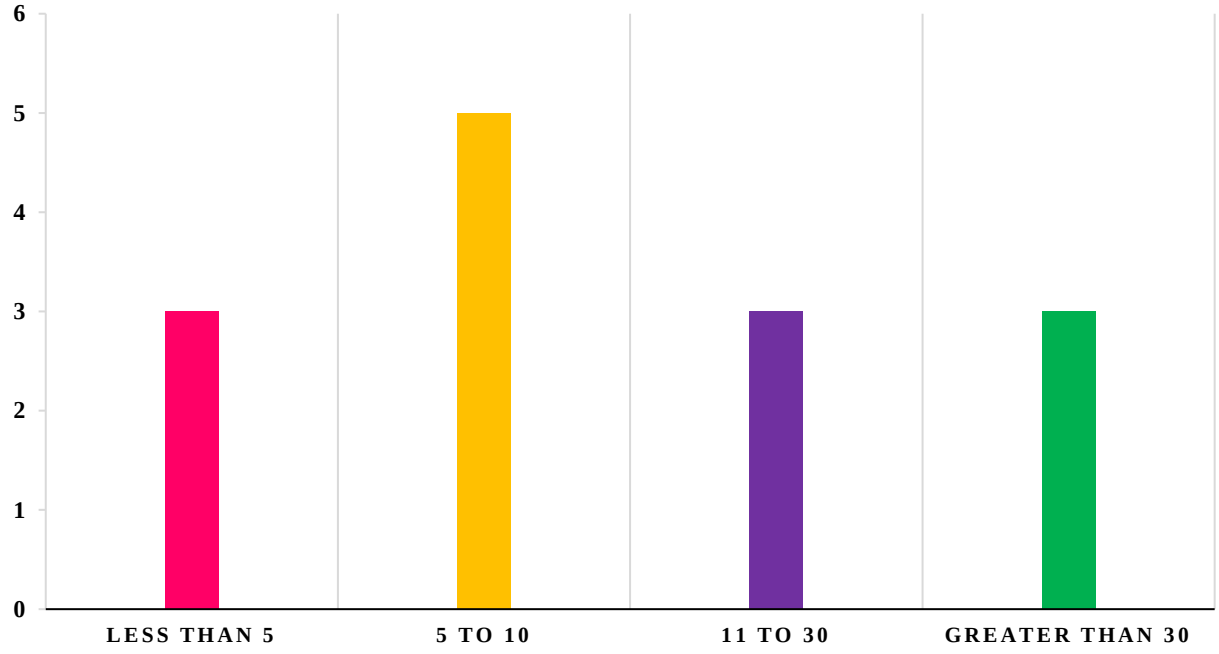

Figure 1. Number of Machinists in the Companies

The survey requested information about the state of their companies. Of the companies surveyed, 64% said they were currently growing at a steady rate, while 7% said they were growing at a significant rate, and another 21% said their company was stable. Therefore, over 90% of the companies surveyed reported growth at the company level, further reinforcing the need for more machinist to fill openings at growing companies. While steady growth may not require every company's workforce to increase immediately, the overall growth of so many companies indicates that as a whole they will need more qualified workers to keep pace with their growth.

Companies were asked to describe what part of their business was directly related to machining (Figure 2). Of the responding 14 companies, half considered machined products to be their primary business, while only one company said that machined products were a portion of their business and sold to a third party. Three companies reported their machining was in support of other business functions, such as an in-house maintenance shop. The remaining three

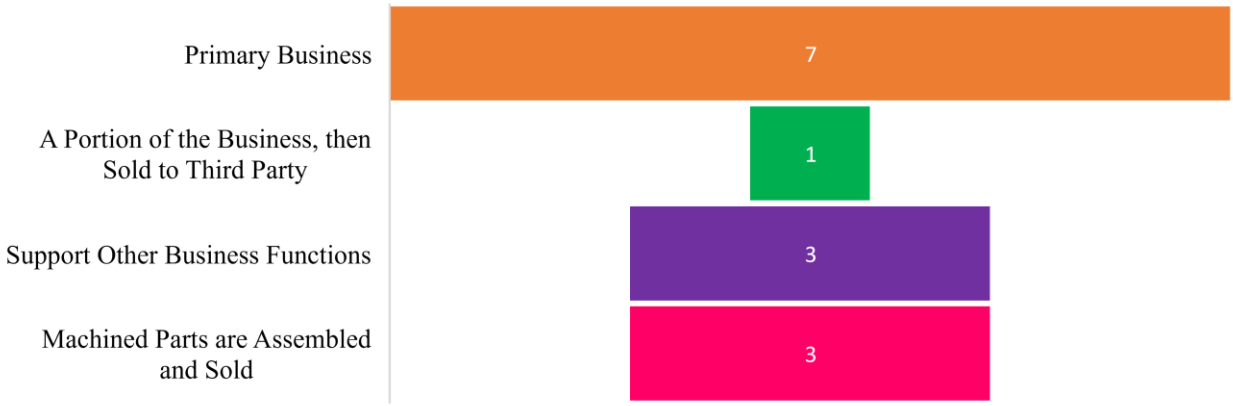

Figure 2. What Part of the Company is Machining?

companies produced machined parts that were assembled and sold to a reseller or directly to the end user.

Companies were asked to divide their machinists into three skill categories, then list how many of each category they employed, as well as an average wage. The division of worker's skills varied significantly from company to company. On average companies responded that 18% of their machinists would be considered unskilled. Multiple companies reported having zero unskilled workers, implying all their machinists are actively engaged in a training program. Entry level machinists were 48% and the high skill category included 34% of all the machinists represented in the survey (Figure 3). High skilled machinists are those who are well versed in all

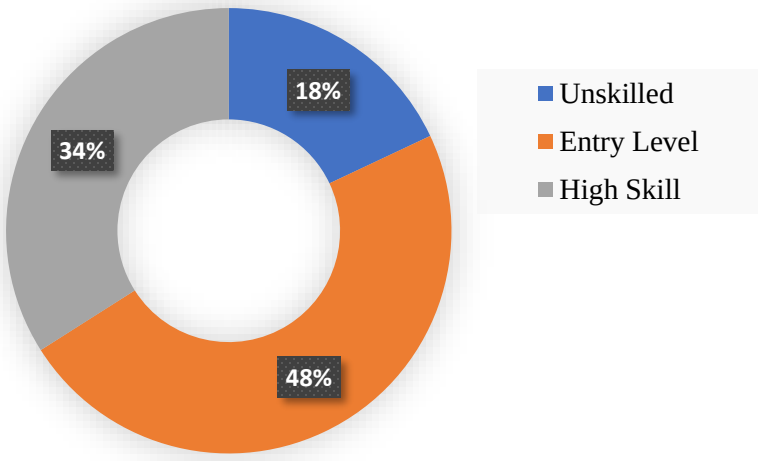

Figure 3. Distribution of Machinists

aspects of their job and require minimal or no assistance to produce parts and carry out their tasks during the workday. Many of these machinists may have also completed an apprenticeship program and are recognized as journeymen in the trade. Wages of these three categories of machinists varied among the companies. Hourly wage rate for the unskilled machinists varied from $10 to $22 with an average of $14. Average hourly wage for entry level machinists was $16 (14.2% higher than unskilled) and $23 (43.75% higher than entry level) for high skilled machinists (Figure 4).

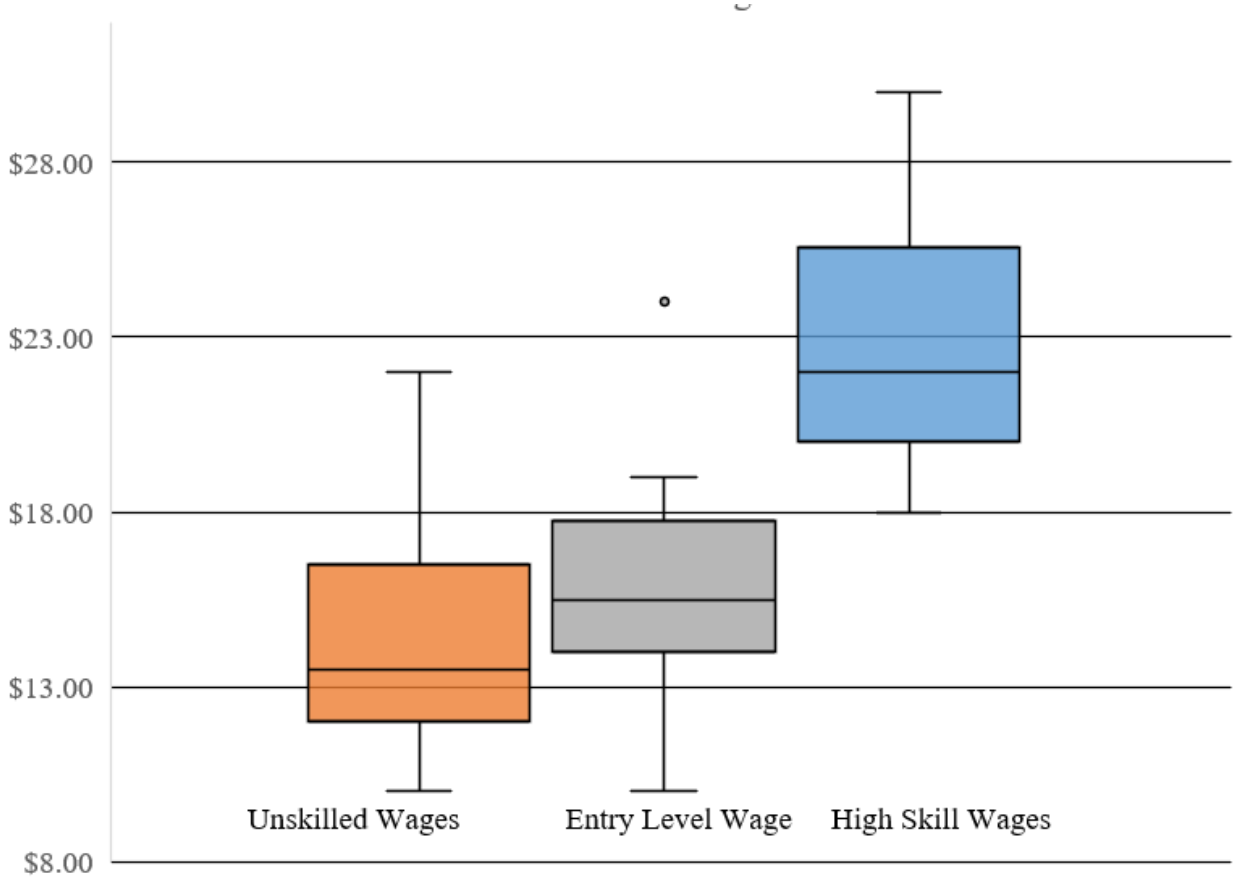

Figure 4. Distribution of Machinists Wages

The second part of the survey focused on machinist job openings at the companies. The companies reported 9 open positions for the lowest skill bracket, 9 positions for entry level personnel, and 12 for the high skill level. This is a total of 30 open positions compared to the total of 313 machinists in the survey. This translates into 9.6% job vacancy in machining companies in the tri-Cities region. Half of the companies also reported that they have difficulty filling open positions. Some of these have so much difficulty, they have been forced to hire

inexperienced personnel and train them in house. It also takes longer time, an average of eight weeks to fill a new position. This means not only are the companies struggling to find qualified workers, but they may have to work shorthanded for long periods of time, potentially affecting their overall business. The primary reason reported at all skill levels for this was a "Lack of technical or job specific skill." For high skill positions, companies reported the second most common factor to keep applicants from accepting job offers was an unwillingness to work at the offered compensation level. Entry level applicants were most frequently not hired because of their poor soft skills that limited their success.

For anyone looking towards machining as a career path, the implication is that it is important to start with a formal training program. One of the most common paths is an associate degree at a community college, which gives the student the necessary skills to begin working as a machinist. With over half of the responding companies valuing a degree, completing college prior to employment will allow a new employee to quickly begin growing their skillset. Helping them to advance rapidly, not only in their position but in pay and benefits as well.

The last part of the survey focused on the potential retirement of the machinists in their companies. Companies responded that almost 15% of their current machinists were retirement eligible at the time of the survey. This number alone shows a major demand for more machinists, but when combined with the current job openings and the struggles companies are already having filling positions, the outlook is that filling these openings will not be easy. Further complicating this fact, is that retirees are more likely to be senior members of the staff with years of experience and knowledge that cannot be quickly replicated.

CONCLUSIONS

Retirement eligible employees, stable growth, and an already insufficient workforce indicate that companies are going to struggle to find the machinists they need to stay competitive. These three factors are the most compelling results to suggest that the skills gap should be a major concern for local industry that employs machinists. While many reports and studies forecasted a future shortage of workers, this survey finds it is a current issue that is already creating challenges for our local industry.

From the survey results, it is obvious that machining is a strong part of manufacturing in our region. There will still be a need for machinists, not just in the short term, but for decades to

come. Unfortunately, the challenges in continuing to educate and encourage young adults to pursue a career in machining do not have an easy solution. While the jobs are available and possess an enjoyable challenge, the entry level wage may be a barrier to entry for many young people who are looking to start a family and gain their independence. Of course, as demand increases for qualified machinists, the wages will most likely increase to attract more employees. Based on these results, companies and educators need to work together to recruit more young people, who are preparing for college, to choose a career as a machinist.

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Appendix A:

Click the following link to view the survey.