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Precision Manufacturing in the Cnnecticut River Valley and Westfield, Massachusetts

Tara Lynn Gehring
University of Massachusetts - Amherst, tgehring@larp.umass.edu

University of Massachusetts Amherst

Department of Landscape Architecture and Regional Planning

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A Master's Project

By

Tara Gehring

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Approved as to style and content by:

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John R. Mullin, Committee Chair
Landscape Architecture and Regional Planning

_____

Henry C. Renski, Committee Member
Landscape Architecture and Regional Planning

_____

Elisabeth Hamin, Department Head

Introduction

Purpose

Industry has thrived in the Connecticut River Valley since the middle of the seventeenth century. The Valley has a strong precision manufacturing history, which began in 1777 with the Springfield Armory in Springfield, Massachusetts. Industry is important to keep the economy of an area balanced, as it provides a solid tax base for any municipality. The Springfield Armory reinvented the gun making industry in the Connecticut River Valley and affected the way industrialization developed in the United States through the invention of the Blanchard Lathe and the development of the interchangeable pieces in manufacturing. Presently, the center of the Valley, specifically the Springfield area, is dominated by small precision manufacturing firms. The Pioneer Valley Planning Commission's Plan for Progress Report states that one of Massachusetts's goals for the Connecticut River Valley is to sustain the precision manufacturing cluster in the area.

This study will attempt to make a contribution towards understanding how to sustain the cluster of precision manufacturing in the Connecticut River Valley. It will describe what precision manufacturing is, identify what a cluster is and identify what makes the conglomeration of precision manufacturing shops in the Connecticut River Valley a cluster, and help find ways the state and local governments can contribute to the growth of the cluster already in place.

Precision manufacturing is defined as the manufacture of individual pieces with extreme accuracy. This type of machining is used to make parts for various machines, including medical, aeronautical, and any other industry that requires identical parts to be created in large quantities. Precision manufacturing requires highly skilled workers to operate different machines to ultimately produce the desired piece. Precision manufacturing is still clustered in the

Connecticut River Valley today, and keeping this manufacturing job base in the area is important to the economic health of the Valley and the following research will show how important this industry is to the Valley.

Connecticut River Valley Demographics

The Connecticut River Valley comprised of 187 communities which are in 8 different counties, Windham County Vermont, Sullivan and Cheshire Counties New Hampshire, Franklin, Hampshire, and Hampden Counties Massachusetts, and Hartford and New Haven Counties Connecticut**.** Landscapes are varied, from still in production farms to dense urban cores. This range of lifestyles has allowed the area to become what it is today, a place that people choose to live and work in. The populations within this area are diverse, and the ethnicities vary from town to town. A little more than 2.6 million people live in these eight counties.[1] Within this population roughly 115,000 people are employed in manufacturing jobs. Out of the eight counties, Hartford has the most factories, 1,268 in 2011. [2] The Connecticut River Valley has over 45 colleges or universities within it, and as a result a large proportion of the population is college educated or work in higher technology jobs**.** The area is connected by Interstate 91, which creates a direct way for people, technology, and companies to travel from the southern to the northern part of the state. The Connecticut River Valley is a beloved area for both citizens and tourists alike, and it provides a strong manufacturing environment for people to use their skills.

Manufacturing in the Connecticut River Valley

The Connecticut River Valley boasts 115,000 jobs in the manufacturing field. The eight counties that make up the Valley have 3,586 manufacturing businesses. This includes all kinds of

[1] 2010 U.S. Census
[2] United States Census Bureau- 2011County Business Patterns

manufacturing, from food production to electrical equipment manufacturing. Some of the highlights of these counties are Hartford County, which has 1,268 manufacturing locations, which hire 45,972 people, and have a total of $3,043,835 annual pay roll. Hampden County has 608 manufacturing facilities with a total of 20,243 workers. The annual total payroll for Hampden County manufacturing is $1,023,434,000 dollars. Cheshire County has 126 manufacturing locations, with 4,896 employees and an annual payroll of $224,337. The total of the eight counties annual industry payroll totals $6,751,650.

The Numbers: Precision Manufacturing

The United States Census did not have a category specified for precision manufacturing, but for my purposes I used the category called "Machine Shop". The definition of this category is,

"This U.S. industry comprises establishments known as machine shops primarily engaged in machining metal parts on a job or order basis. Generally machine shop jobs are low volume using machine tools, such as lathes (including computer numerically controlled); automatic screw machines; and machines for boring, grinding, and milling." (U.S. Census Bureau)

The following table compares statistics on fabricated metal product manufacturing in the eight counties in the Connecticut River Valley.[3]

[3] United States Census Bureau- 2011 County Business Patterns

	Number of shops	Number of employees	Annual payroll (in 1,000)
Hartford	140	1,995	$116,529
New Haven	69	919	$52,818
Franklin	3	-	-
Hampden	74	1,402	$82,704
Hampshire	12	59	$2,328
Cheshire	14	244	$12,275
Sullivan	11	252	$11,942
Windham	2	-	-

These numbers clearly show the large impact precision manufacturing shops have on the Connecticut River Valley. Clearly the density of these types of manufacturing shops is centered in the middle to southern portion of the Valley.

Research Question/Problem

How can the local and state governments as well as other government organizations encourage precision manufacturing in the Connecticut River Valley and Westfield, Massachusetts to remain in the Valley and strengthen this industry further?

Goals

The goals of this project are to,

1. Describe where Connecticut River Valley precision manufacturing is
2. Using Westfield, Massachusetts as a case study, determine what precision manufacturing companies need for growth and sustainability,
3. Find ways state and local governments can contribute to the growth of the industry in Westfield, Massachusetts and in turn, Connecticut River Valley as a whole.

Methods

To accomplish the goals and answer research questions research will be done through field work, library research, reading planning documents, and research of theoretical construct of placement theory. Field work will consist of visual inspection through site visits, photographs, and mapping documents, and informal interviews. These informal interviews will be done in person with shop owners, heads of manufacturing associations, and employees within the field of precision manufacturing. A standard questionnaire will be prepared to distribute to each of the categories above to ensure that the same questions are asked and answers are found for all of the questions, ensuring that all precision manufacturing shops in the City of Westfield are represented.

Library research will gather materials from planning documents, academic journals, and books on the following subjects. The history of precision manufacturing's presence in the Connecticut River Valley and the history of manufacturing in general in the Valley will be researched. This will give the background information about the industry that is necessary to understand the precision manufacturing cluster that is in place today in 2014. Trade publications for precision manufacturing will also be found. These publications will allow the research to include what the industry believes is happening and will happen in the future. Literature on projections of future trends will be important to find as well. These projections relate to the trade publications as they will show what is predicted to occur within the precision manufacturing industry in the Connecticut River Valley and the United States. Placement theory gives the reasons why certain industries locate where they do. The theory that will be focused on for precision manufacturing in this research will be cluster theory. Specifically cluster theory will be researched, focusing on Porter's Diamond, which is explained below.

The next step in the research process will be to research the theoretical construct of placement theory through the interpretation of Porter's Diamond. Michael Porter's "Porter's Diamond of National Advantage" can be used to show how precision manufacturing companies interact and effect other manufacturing industries in the Pioneer Valley. The topics within the diamond are: firm strategy, structure, and rivalry, demand conditions, related and supporting industries, and factor conditions. These are all interconnected and show how manufacturing industries depend on each other.

The final step of research will involve locating and reading planning documents that pertain to the precision manufacturing industry from the state of Massachusetts, the regional level, and the city or town level. These types of documents will show how much the government is interested in the industry.

Project Chapter Outline

This study is organized as follows. The first chapter, the Literature Review, will cover the history and evolution of precision manufacturing, the definition of precision manufacturing, and placement theory of precision manufacturing. Following a review of literature will be a review of interview findings, and finally summary and conclusions will include what needs to be changed in order to keep and expand the precision manufacturing cluster in the Connecticut River Valley.

Literature Review

History and Evolution

Manufacturing in Massachusetts and Northern Connecticut began about twenty five years after the colonies were settled, by the Puritans. John Winthrop realized that Eastern Massachusetts would be a perfect spot for an iron works factory, with the abundance of iron ore and firewood.[4] By 1646, the first factory in America was completed, the Saugus Iron Works.[5] The Saugus Iron works was a blast iron factory that utilized water wheels to make power. English and Scottish men were brought to America to work in this factory. These men had the necessary skills to turn the iron ore into usable product. The Saugus Iron works was economically viable until 1668, only twenty two years. The cost for the skilled workers was becoming too high, and the amount of iron coming from England was increasing. Despite its short life, these iron works effected Massachusetts and Connecticut in a profound way.

After the decline of the large Saugus Iron works, small shops and individual homes began to produce iron. These small iron working shops were called bloomaries. Bloomaries are defined as a small iron working factory that created wrought iron in quantities less than four hundred pounds a day.[6] The largest bloomaries were in Taunton, Massachusetts and northern Rhode Island. The men that had been brought to the colonies to work in the Saugus Iron works moved

[4] When dredged, the many swampy bogs produced iron ore rich mud close to the surface.[4] The combination of available iron ore, trees, and space led to Winthrop travel back to England to observe the iron works factories already in use in order to build a comparable one in America. The English realized that the production of iron in the New World would be an advantage to both the Europeans and the new settlers because of the harm factories were causing in England. Iron ore and trees were running low and pollution was becoming an issue with its citizens. If the colonists created their own iron, less would need to be exported to America and if enough could be produced the Americans could possible export the iron to England. Winthrop returned to Massachusetts with money from investors in England as well as skilled workers who knew how to build and work in an iron works factory.

[5] "Saugus Iron Works: Life and Work at an Early American Industrial Site." *National Park Services*. N.p., n.d. Web. 15 Oct. 2012.

[6] Woodman, Walter C. "Sagus Iron Works 1647." *American Society for Mechanical Engineering*. N.p., n.d. Web. 10 Oct. 2012.

throughout New England and were the workers that expanded the iron industry in American. By 1700 the demand for iron in America was increasing as the population began to drastically increase.[7] Within twenty years the iron ore stores that had been in Eastern Massachusetts were running low, and the iron industry moved as far north as Maine and south to Maryland. The iron industry ran along the Adirondack Mountain chain, which included part of Western Massachusetts and Northern Connecticut.

As the colonist population spread from the coasts to the western parts of Massachusetts and Connecticut, surveyors were employed to find suitable locations for new towns. Salisbury, Connecticut was one of these locations that was chosen for new development. However when the surveyors approached the area their compasses began to move erratically they realized that huge deposits of iron ore were close to the surface in the large hill in town.[8] Iron works technology and skilled workers spread out throughout New England in the beginning of the eighteenth century and Salisbury was one of the most popular locations. In 1732 Thomas Lamb moved to Salisbury from Eastern Massachusetts, bought five thousand acres of land and opened a bloomary. Shortly after, four other factories were opened in Salisbury. As the demand for iron increased in the growing colonies the first blast furnace was built in 1762. The industry grew even more during the Revolutionary War, when the Salisbury area factories produced about 80% of all of the iron needed for ammunition and cannons for the American army.[9] At the iron industries peak, the mid-1800s, in Western Connecticut there were forty blast furnace factories in business. About five hundred men worked in this industry and they produced between 2,000 and

[7] Other blast iron factories were built to keep up with demand, Pembroke, Marshfield, Middleboro, and Carver, all in Massachusetts.
[8] Barber, John W. *Connecticut Historical Collections: History and Antiquities of Every Town in Connecticut*. N.p.: Durrie, 1837. Print.
[9] Barber, *Connecticut Historical Collections: History and Antiquities of Every Town in Connecticut*.

2,5000 tons of pig iron a year. [10] Although the large blast furnaces produced mass amounts of usable iron, the small bloomaries were not eliminated. These small shops created intricate pieces with iron, such as nails and utensils. Both types of iron working factories required skilled workers, many of which were taught the craft by the workers from England and Scotland. The iron making technology spread throughout the northeastern colonies and with it new technology and specialized workers also migrated from the coastal areas to the interior.

Technology and skilled worker movement throughout the colonies changed the American landscape from completely rural to having pockets of urbanization and industrialization from the end of the 18th century onward. The extensive iron industry in New England allowed the American government to have the raw materials they needed to succeed in the Revolutionary War. In 1777, the Springfield Armory was opened. George Washington, the commander of the American forces during the Revolutionary War, decided that Springfield, Massachusetts was the perfect place to make, store, and repair guns for the United States military. The armory was first opened in a small barn in the center of Springfield with the purpose of repairing damaged guns.[11] Slowly over the next thirty years the armory expanded into larger buildings and began to manufacture guns. The United States government realized that if guns were assembled with interchangeable parts they could be fixed easier and faster on the battlefield, giving their army a competitive edge over their enemies. The "modernization" of manufacturing began at the Springfield Armory, "The national armory at Springfield, Massachusetts, played a major role in this process [the use of interchangeable parts with small arms], especially in its efforts to coordinate its operations with those of the Harpers Ferry Armory" (Hounshell 3). The creation of interchangeable parts was possible through the invention of the Blanchard Lathe.

[10]Barber, *Connecticut Historical Collections: History and Antiquities of Every Town in Connecticut.*
[11] Forge of Innovation: The Springfield Armory, http://www.forgeofinnovation.org/

The Blanchard Lathe was invented by Thomas Blanchard, an employee at the Springfield Armory in 1819. Prior to inventing the lathe, Blanchard invented a machine to produce tacks at a rate of five hundred per minute.[12] His next invention was a machine that shaped the outside barrels of muskets, making them uniform from end to end. This used a copy of an already produced gun barrel to guide the lathe to produce mass amounts of identical barrels. This machined virtually eliminated the need to grind down gun stocks by hand, it only required an employee to run the machine. The managers of the Springfield Armory realized that the invention and use of similar machines to this one could be extremely beneficial to the company and contacted Blanchard. The Springfield Armory and Thomas Blanchard came to an agreement, the armory gave him a space to work and any materials he needed in exchange for the use of his machines. He also received thirty seven cents per musket stock made by his machines[13]. With all of these resources in place, Blanchard invented the Blanchard Lathe.

According to Hounshell, the Blanchard Lathe, "was a truly elegant invention that reproduced in wood the irregular shaped object such as an ax handle or a shoe last." (Hounshell 35). It turned and finished gun stocks in a single step, creating the octagon shape using specifically timed vibrations. The specifics of the lathe are described by John Leander Bishop as, "successively brought in contact with a small friction wheel; this wheel precisely regulates the motion of chisels arranged upon a cutting wheel acting upon the rough block, so that as the friction wheel successively traverses every portion of the rotating pattern, the cutting wheel pares off the superabundant wood from end to end of the block, leaving a precise resemblance of the model." (Bishop 22) This complicated explanation describes how the lathe used the same

[12] Bishop, J. Leander, Edwin T. Freedley, and Edward Young. *A History of American Manufactures from 1608 to 1860* ... Philadelphia: E. Young, 1866. Print
[13] Hounshell, David A. *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States.* Baltimore: Johns Hopkins UP, 1984. 38

"program" over and over to create mass amounts of identical gun barrels in no way a human ever could. Now employees in the Springfield Armory worked with machines instead of their hands, making it possible to produce more guns in a shorter period of time and virtually eliminating mistakes made by individuals. As Hounshell says, "By the end of 1826 he [Blanchard] had perfected his battery of machines, now fourteen in number, and had eliminated the use of skilled labor in stockmaking" (Hounshell 38). Instead of needing to be able to manufacture by hand, the workers now needed to be able to operate complex machines that created the pieces. [14] The Blanchard Lathe was improved and allowed mass production to happen at a fairly quick rate. These machines virtually eliminated the chance of a worker making a mistake and ruining an entire days worth of work. Lathes allow for inspectors to check the first piece from the machine and make sure it is faultless. Once the first piece has been verified as correct, the worker can then fulfill the quota for the day and make the pieces without mistakes. [15] The Blanchard Lathe forever changed industry. It began the process of mass production and allowed interchangeable parts to become standard in American industry.

The Springfield Armory proved to be very important in the history of industry in the United States. Interchangeable parts, mass production, and the change over from hand crafting to machining are some of the most important advances the armory promoted. Thomas Blanchard continued his work at the Springfield Armory after the invention of the lathe, and as Hounshell states, "But this machine alone would not have so easily pointed the way had Blanchard not linked it sequentially with additional and more special-purpose machines that carried out the remainder of operations on the stocks such as recessing for the barrel and lock and mortising for

[14] Butterman, Eric. "Thomas Blanchard." *American Society for Mechanical Engineering*. N.p., Mar. 2012. Web. 8 Oct. 2012.
[15] Butterman, "Thomas Blanchard."

the trigger mechanism. Hand labor was virtually eliminated." (Hounshell 35). Other gun making companies in Southern New England used similar techniques.[16] All of these gun making companies utilized interchangeable parts, mass production, and lathes to manufacture huge amounts of guns that eventually were used in the Civil War and the "taming of the west"[17].

The American Civil War promoted even more technological advances at the Springfield Armory. Workers from the armory traveled to Sweden, Germany, and England to learn and improve their technology. The interchangeable parts on the guns the Union Army used proved a significant advantage over the older, outdated technology in the South[18]. A research and development department was created at the armory in 1891[19], and the notion of workers being paid by piece became popular. This increased competition among workers and increased the accuracy of the pieces made, because each botched piece would cause a deduction in pay. [20] The workers from the opening of the armory until the end of the nineteenth century were required to be highly skilled, and were therefore highly paid. Three major events in American history promoted the United States gun technological advances, the Mexican-American War, the Civil War, and the expansion of American citizens to the western part of North America.

The Springfield Armory had a significant impact on the manufacturing business in the United States and changed the Pioneer Valley, in both populations and employment. Not only were interchangeable pieces and mass production made possible at the armory, but many people

[16] The Colt Revolver was invented and perfected by Samuel Colt who was from Hartford, Connecticut. Horace Smith and Daniel Wesson, also working in Connecticut, formed a partnership and invented the first lever action repeating pistol. The Smith and Wesson Company went on to create cartridge revolvers which they continued to improve throughout the nineteenth century.
[17] http://www.forgeofinnovation.org/
[18] Bishop, *A History of American Manufactures from 1608 to 1860*
[19] Bishop, *A History of American Manufactures from 1608 to 1860*
[20] Hounshell, *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States*. 35

who worked and learned here spread throughout the country and improved industry even more. One example is Horace Smith, of Smith and Wesson, who was an apprentice at the armory. Many other mechanized items were invented and perfected in the Pioneer Valley, such as Howe's pinmaking machine, Eli Terry's patented pillar and scroll clock, and Joseph Ives's brass clock[21]. The manufacturing boom that occurred in the United States at the end of the nineteenth century was a direct result of the advancements made at the Springfield Armory. As stated in Hounshell's book *From the American System to Mass Production 1800-1932,* "The significance of events at the Springfield Armory from 1794 to 1815 is that here armsmaking was transformed from a craft pursuit into an industrial discipline and the weapon from a shop creation into a factory product." (Hounshell 33). Both World Wars increased the demand for guns and therefore increased the number of workers in the armory. Just after World War I, John Garand came to the armory with an idea for a semi-automatic weapon. Garand and the research and development department created the M1, or the Garand rifle, in 1924. The amount of skilled workers in the area increased as many of the men working in the factory were drafted. During World War II, about forty percent of the workers were female.[22] The Springfield Armory was closed in 1968, but its effects on the Pioneer Valley are significant, it gave people an important skill set and set the economic tone of industry.

The Pioneer Valley created the spark that was necessary for the Industrial Revolution in the United States. The invention of the Blanchard Lathe was extremely important in the manufacturing revolution; it changed the entire manufacturing process from hands on to machine based. If this machine had not been invented in 1819, many of the other manufacturing advances

[21]Hounshell, *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States*. 52-58
[22] http://www.forgeofinnovation.org/

may not have been possible. The Springfield Armory was the location where Thomas Blanchard invented the process of interchangeable parts and mass production. This has caused Springfield, and the Connecticut River Valley, and the history of manufacturing to be forever intertwined. The area not only produced large amounts of guns, but these locations were also prime early manufacturing areas. Columbia Bicycle, Indian Motorcycle, and Singer Sewing Machine Company were all located in the Springfield area. Many other world famous companies started their businesses in this area, proving that the Connecticut River Valley was not only a gun manufacturing center, but a center for manufacturing and technological advances in the late nineteenth century. The Connecticut River Valley gave the manufacturing industry the "spark" it needed to grow and change into what it has become today.

Westfield, Massachusetts

The city of Westfield historically was a center for manufacturing in the late nineteenth century. Westfield is located in the western part of Massachusetts, to the south of Easthampton and west of Springfield. The city was first settled in 1640 and joined the town of Springfield in 1649. Westfield was the western most community in Massachusetts at this time and served as an important trading post and military base.[23] As the area grew, Westfield became its own town in 1669 with the economy consisting mostly of agriculture. The fertile lands and abundant water ways allowed agriculture to flourish as well as the lumber and flour industries. The agricultural focus changed in the late 1800s, when the manufacturing boom took Westfield by storm. The Westfield River proved to be essential in this development, as many small mills opened along its banks.[24] The river was not the only natural resource that promoted manufacturing, the geography

[23] http://www.cityofwestfield.org/index.aspx?NID=245

[24] Some of the most important industries in Westfield during this time were buggy whips, bricks, cigars, bicycles, paper, pipe organs, textiles, wood products, and precision tools.

and forest lands of the city were also important. Westfield is located along the Route 90 corridor, which is a road that runs east-west through Massachusetts. This road existed in the late 1800s and allowed products to travel to and from Boston and the urban core of the state. The forests, grasslands, and abundance of stone were also important in the development of industry.

Today, most of these industries have left Westfield, as many other mill towns in Western Massachusetts. However, the city is home to the third largest factory in the Pioneer Valley, Mestek. The precision manufacturing industry is still present, with 26 different machine shops within the 47 square mile city. The current population of Westfield is 45,450 and of that population, 2,912 people, or fifteen percent, work in some sort of manufacturing. According to the 2010 Census, 60% of Westfield's citizens traveled outside city limits for work. This is typical of machine shops, many employees travel away from their city of residence to go to work. Westfield is still located in an ideal location, the Mass Pike, or route 90, runs directly through. The north-south route, 91, is also close, just a short drive through neighboring West Springfield. These important routes have led to Westfield being home to many warehouses owned by large corporations, such as Home Depot and Lowes. Westfield, Massachusetts was a thriving mill town in the late nineteenth century and has transformed into a center for machine shops in the Connecticut River Valley today.

Manufacturing and Education

The strong precision manufacturing industry in the Pioneer Valley is reflected in the educational curriculum and college majors offered in the areas school. Springfield Technical Community College's manufacturing major boasts a 100% job placement or continuing

education rate[25]. According to the program's director, Gary J. Masciadrelli, each of the twenty graduates from the spring 2012 semester either was hired at a precision manufacturing company or continued on to a four year college in a similar major. During the fall of 2012, the major currently has eighty students enrolled. When Masciadrelli was asked if the precision manufacturing students were in high demand, he stated, "Absolutely! Manufacturing is poised for a huge comeback in MA. Pratt & Whitney has more business than they have seen in 20 years. We are working with them on a summer intern program for the summer of 2013." (Gary J. Masciadrelli). The area's vocational high schools all offer manufacturing programs including, Westfield Vocational High School, Dean Technological High School in Holyoke, Pathfinder Vocational High School, Chicopee Vocational High School, and Northampton Vocational High School. All of these schools have manufacturing shops that teach students the necessary skills to go directly into the job force after graduation. Westfield Vocational High School currently has 54 students in grades 9 through 12 enrolled in the manufacturing program[26]. A discussion with the manufacturing chairperson from the school, Clement Fucci, showed that the job placement rate for graduates is almost at 100%. He said that between 90 and 100% of seniors in the program enter into a cooperative program through which they work full time at a precision manufacturing shop while still enrolled in school. Another option for students is to work part time for a manufacturing shop and attend Springfield Technical Community College while their employer pays for tuition and fees. When asked how students are chosen for the manufacturing program, Fucci said, "Our program reflects the type of high skilled workforce our mfg (manufacturing) companies possess. So we identify skills in young people that will make them employable upon graduation in a mfg (manufacturing) career path." Westfield Vocational High

[25] Gary J. Masciadrelli- Springfield Technical Community College
[26] Clement Fucci- Westfield Vocational High School

School searches for students that will make great manufacturing employees, which will help the Pioneer Valley's precision manufacturing cluster grow. Fucci also mentioned that Westfield Vocational High School was recently visited by the state of Massachusetts Education secretary and the program was named the best in the state.

Vocational high schools are a very important factor in the survival of the precision manufacturing cluster in the Pioneer Valley. Many of the owners and stakeholders in the precision manufacturing companies have shown interest in the education and training of the younger generations in order to grow the industry[27]. The current population of workers in the industry is aging, and machine shops have shown concern in finding suitable workers to replace them. There has been a social stigma in regards to vocational high schools in the past as places for students who are not "smart" or "able to learn"[28]. The truth is quite the opposite; they offer opportunities for students to go directly from high school to careers, usually relatively high paying ones. The manufacturing trade in particular has had a bad image in the past as a dirty and hard job, one that requires constant physical labor. This could not be further from the truth in regards to the precision manufacturing field, as the factories are very clean and require relatively little physical work. This type of manufacturing has more to do with the ability to run a computer on a machine rather than working on an assembly line. Jobs in this field typically provide forty hours of work a week with at least fifteen hours of overtime available as well. Even though hours can be long, the work is not physically taxing and can result in a yearly salary of roughly $50,500 per year.[29] Educational institutions will prove to be very important in the survival of the precision manufacturing industry in the Pioneer Valley, as the industry requires educated workers in order to grow.

[27] Michael J. Graney, Glen W. E. Ford
[28] Goldstein, Dana. "The Future of Vocational Education." *The Nation*. N.p., 19 Apr. 2012. Web. 11 Nov. 2012
[29] U.S. Census Bureau

The Growth of the Precision Manufacturing Industry Today

The precision manufacturing industry works with small batches, allowing companies to work on many different projects at the same time, which increases the flexibility of workers and machine shops. The small shops also make the industry stable, as the small shops are able to meet fluctuations in the market when they happen, in contrast to large manufacturing plants. Another reason why small machine shops are able to meet market demands is because their workers can work more hours, overtime, and finish the job quickly.[30] Competition amongst precision manufacturers is intense throughout the United States, and it drives technological advances and lowers prices for buyers of the products. When new technological advances are made in the field, operating costs are usually lowered, and shops become more efficient, lowering the prices further for buyers. "There is an increasing technical complexity of products being manufactured today. This complexity is evident in both the number of parts or components comprising a device as well as the sophistication of device performance or operation" (Dornfeld 2008, 9). The complexity of the precision manufacturing industry today in the Connecticut River Valley is constantly changing and evolving, as it always has been in the past.

Definition

Precision manufacturing is an industry that cuts primary metal products into useable pieces that are identical and perfectly crafted. Metal is cut with extreme accuracy through different processes, including lathe, milling, and grinding machines. Many of the definitions and descriptions of precision manufacturing comes in text books and fact sheets about the industry. Precision manufacturing is defined in the IBIS World report as, "…a collection of material-

[30] Samadi, Nima. "IBIS World Industry Report 33217 Machine Shop Services in the US." *Ibis World*, no. December 2012 (2012) 6

working processes that involve powered tools such as lathes, milling machines and drill presses to shape materials. Machining is involved in almost all forms of metal product fabrication, though machining may involve materials other than metal" (Samadi 2012, 2). Not only does precision manufacturing create metal pieces, but it ensures that "all requiring components with complex shapes and exacting tolerances" (Dornfeld 2008, 3).

Precision manufacturing is also defined as the manufacture of individual pieces with extreme accuracy. This type of machining can be used to making parts to all different kinds of machines, including medical, aeronautical, and any other industry that requires identical parts to be created in a large quantity. Within the precision manufacturing field, there are different jobs that machinists can do. Specifically, a machinist can work in drilling and boring, electric discharge machining and electrochemical machining, grinding, milling, sawing, tap and threading, and turning, as well as others.[31] Each of these tasks has its own special role in the manufacturing process. Precision manufacturing requires highly skilled workers to operate different machines to ultimately produce the desired piece. Precision manufacturing companies are typically also called original equipment manufacturers, or OEMs. An OEM is a company that creates products for another company to use when making a finished product. This is what the precision manufacturing industry does, they do not make finished products; they make the pieces that are needed by other manufacturers to complete their product. One example of this is Boeing Aircraft. They do not make the components that make up the engine of the jets; different precision manufacturing companies make these and then sell them to Boeing. This is only one example of what an OEM can be, they can make any type of metal product that is sold to a larger company that use them to assemble something larger. Precision manufacturing is a process that requires

[31] Samadi, IBIS World Industry Report 33217 Machine Shop Services in the US. 2

parts to be built to high standards and tolerances so the finished products can function reliably and for a long period of time. They must also be affordable. The demand for precise and low cost parts has led to constant technological improvement and specialization within individual shops. One of the most important technological improvements has been the invention of machines programs that allow a machine to be reconfigured quickly without being completely re-designed.[32] This is all important because it sets precision manufacturing apart from other types of manufacturing, as it is extremely important that each machinist know how to use multiple types of machines and can change programs rapidly.

In precision manufacturing shops the customer company will send a blueprint with specific tolerances for each piece of metal to the manufacturing company. The machine shop then reads these blueprints and creates a program that the machinists can use. The machinist then creates the piece, checks it for accuracy, and then sends it back to the customer. As an example, "bar stock" is crafted by taking a long bar of metal and cutting it into lengths that are specified on the blueprint. A machinist will take the bar of metal and perform various cutting applications on it in order to make it exactly what the customer orders. The piece begins as a bar of metal and is transformed through various steps into a usable piece.

The precision machining industry requires that metal products go through at least seven different steps or departments before they are final products. These departments are: general machining, milling, grinding, lathe, programming and set up, production operations, inspection, and job planning. The first kinds of jobs require a person to understand how to use a lathe-type machine and create the actual metal pieces that are the final products from the shop.

[32] Dornfeld, David, Dae-Eun Lee, and SpringerLink (Online service). *Precision Manufacturing.* Boston, MA : Springer Science+Business Media, LLC, 2008. 7

A machinist is a person who runs and controls a machine in a shop. This person can move from machine to machine throughout the day or can be stationary at a specific machine for the entire day, depending on the size and number of people working. The purpose of these machines is to cut and shape metal into a usable piece that is made to match a set of blueprints or tolerances exactly. The milling department cuts and shapes metal products by keeping the piece of metal stationary and the machine moving around it. The grinding process uses multiple cutting wheels to shape the metal pieces, keeping the machine stationary and the part moving. The lathe department is the original machine shop piece; it is another machine that cuts metal, in which the piece of metal is moving around inside while the lathe stays still. These jobs are extremely important as they are the ones that actually manufacture pieces[33].

The other types of jobs within the machine shop have more to do with logistics and finalization of the metal pieces. Employees in the programming and set up department need to have more knowledge and skills than in the other departments, as they are the ones who take the blueprint of specifications for the final piece and turn it into a computer program that the machines can read. The people working in the set up and programming department need to be able to read blueprints, make sure the measurements are exact, and be able to translate the numbers into a program that the computer can read and use. Production operations is similar to production and set up, as this job's purpose is to double check the computer program that is made for the machines to read. However, the difference is that this job works more with finding the centerlines of the primary piece of metal, and figuring out where the machinist needs to begin to cut the piece in order to make sure it is perfect. Inspection is the final step in the machining process, it is the department that goes through each piece and ensures that the pieces are totally

[33] Steven Hitchcock and Randall Gehring- Industrial Precision Inc

accurate and identical. If the pieces are not perfect, they can cause the larger machine, whether it is medical, nautical, or aerospace to malfunction. The last job in the machine shop is job planning. Job planning maps out the process through which the primary metal is transformed into the final piece. Typically, the job planner will map out a path for the metal to go through, and this path might be from milling to lathe to grinding, and then back to lathe and finally to inspection. Each order that is submitted from the customer will have a different process to go through, so the job planner is for each job[34].

Each job within the precision machine shop is important; one cannot be successful without the others. Although small shops may have employees perform many of these jobs, larger companies may have people employed primarily in one department. Typically machinists are skilled at more than one department, and as a result their labor is in high demand in the Pioneer Valley.

Placement Theory-Cluster

Although the world and almost all businesses are connected by the internet and other technologies, physical location still matters in today's business world. Michael Porter defines a cluster as, "critical masses- in one place- of unusual competitive success in particular fields."[35] Another definition of Porter's is, "Clusters are geographic concentrations of interconnected companies and institutions in a particular field."[36] Although the intricate specifics of clusters are much more complicated than this definition written by Michael Porter, much of the literature discussing clusters agrees on this general definition. (Allio, Feser, and St. John) More

[34] Steven Hitchcock and Randall Gehring- Industrial Precision Inc
[35] Porter, M. E. (1998). "Clusters and the new economics of competition." Harvard Business Review 76(6): 77-90. 3
[36] Porter, M. E. (1998). "Clusters and the new economics of competition." Harvard Business Review 76(6): 77-90. 78

specifically than “companies and institutions”, clusters involve linked industries, entities involved in the same industry that creates competition, customers, manufacturers, raw materials, schools, governments, and industries that produce complimentary products.[37] Clusters involve much more than the specific industry, such as precision manufacturing. Much more is involved within this cluster other than the machine shops that do the precision manufacturing. Involved are customers and suppliers, shipping companies and raw suppliers, similar industries and finishing industries.

Clusters also depend on location. Michael Porter explains, “Enduring competitive advantages in a global economy lie increasingly in local things- knowledge, relationships, motivation- that distant rivals cannot match.”[38] Clusters provide competitive advantage to the industry involved in the cluster by offering all the advantages of a cluster. A manufacturing business that attempts to start up in a location without any similar businesses can suffer disadvantages because there are no other businesses to have relationships with, either friendly or competitive, or to have conversations with, that are beneficial to future growth. This new business will also need to look for customers, suppliers, and other complementary products being manufactured. If the same company started up in a location that already has a cluster in place, all of the pieces needed are already in place. Porter explains the advantages of locating within an existing cluster, “a cluster of independent and informally linked companies and institutions represents a robust organizational form that offers advantages in efficiency, effectiveness, and flexibility.”[39]

[37] Porter, M. E. (1998). "Clusters and the new economics of competition." Harvard Business Review 76(6): 77-90. 79
[38] Porter, M. E. (1998). "Clusters and the new economics of competition." Harvard Business Review 76(6): 77-90. 78
[39] Porter, M. E. (1998). "Clusters and the new economics of competition." Harvard Business Review 76(6): 77-90. 80

Locating in an area that has a cluster already in place is a significant advantage. In the precision manufacturing cluster in the Connecticut River Valley, companies have the chance to all use the same suppliers, the same transportation systems, the same pool of employees, the same government and educational institutions, and the same specialized information.[40] Joining a cluster allows each individual business to benefit as if it had joined with others without having to sacrifice their own goals and objectives. Clusters have benefits for businesses involved, especially with finding raw materials needed and locating skilled employees. For example, the precision manufacturing cluster in the Connecticut River Valley provides manufacturing shops with a pool of workers who historically have been trained in precision manufacturing, and an ample amount of raw material suppliers who have experience with selling the metals that are needed for manufacturing.

Porter's Diamond

Michael Porter's "Porter's Diamond of National Advantage" can be used to show how precision manufacturing companies interact and effect other manufacturing industries in the Pioneer Valley. The topics within the diamond are: firm strategy, structure, and rivalry, demand conditions, related and supporting industries, and factor conditions[41].

[40] Porter, M. E. (1998). "Clusters and the new economics of competition." Harvard Business Review 76(6): 77-90. 82

[41] Porter, Michael E. *The Competitive Advantage of Nations*. London: Macmillan, 1998. Print.

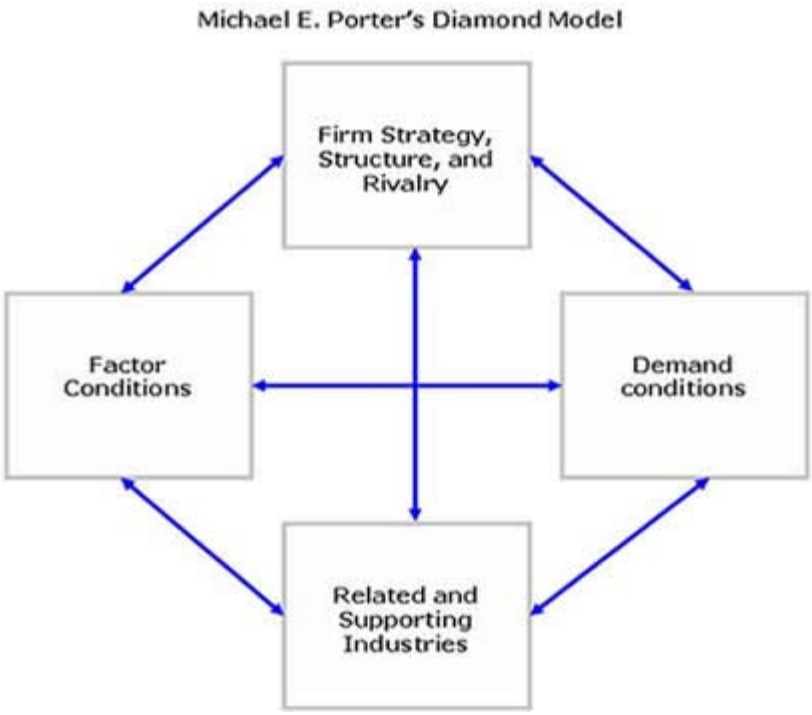

Photo credit- www.Businessmate.org

These are all interconnected and show how manufacturing industries depend on each other, as explained in Michael Porter's "The Competitive Advantage of Nations".

In terms of the precision manufacturing industry, the "firm strategy, structure, and rivalry" section of the diamond most firms that were interviewed agreed that sharing information with other shops is not a sufficient practice. Some of the smaller shops (1-30 employees) said they would share tools or materials with other smaller shops, but the larger shops (30-200 employees) generally did not share at all. The reason for this secrecy is that each shop competes with others for work, whether it be aerospace, defense, or medical equipment being manufactured. Through interviews it was apparent that smaller shops and larger shops have much different structures and strategies. Larger shops generally had more flexibility and could change much more quickly, because of the number of employees, the number of machines, and the financial backing. For

example, if a larger shop was given the opportunity to do a job that is not typically done there, they might be able to change gears more quickly than a smaller shop who has limited employees and available money to purchase required equipment.

Demand conditions require the demand for product to be higher in the local area than in the foreign area under Porter's definition of a cluster. There are two large aerospace companies in Northern Connecticut, Pratt and Whitney and Boeing. The United States Navy has the largest submarine base in the United States in Groton, Connecticut. Both the aerospace and Department of Defense industries are crucial to the survival of the precision manufacturing industry in the Connecticut River Valley. Both of these require extensive work done by precision manufacturing shops. The demand for the types of products that are manufactured in the precision manufacturing shops in the Connecticut River Valley is high locally, because many of the buyers of the end products are located close by. The placement of the precision manufacturing shops visited for interviews depended on the location of aerospace, Department of Defense, and medical contracts. Both smaller and larger shops explained that their current location was chosen because of close by interstates and the airports. Although precision manufacturing products are in demand almost everywhere in the world where manufacturing is taking place, the demand in the Connecticut River Valley is especially high because of the major aerospace and defense industries located within the Valley.

Porter's Diamond next expresses that related and supported industries are the next piece in the cluster puzzle. The precision manufacturing industry has "finishing" that needs to be done on products, such as heat treating, painting, electrical assembly, mechanical assembly, plating, polishing, etching, and anodizing. Some of the larger shops have the capability to complete these tasks within their shop, but many send products out to other companies that handle finishing of

metal parts. The interviews reveled that about 99% of all finishing is done in the New England area, specifically in Western Massachusetts and Northern Connecticut. The only finishing process that was mentioned was a special coating for certain metals that is exclusively done in Arizona, because the inventor has the only license to use the patented technique. The finishing that takes place in New England is priced competitively, because like precision manufacturing there is a cluster of finishing shops in the Connecticut River Valley. These competitive prices help the precision manufacturing shops get a better price and it helps keep most of the finishing work in the vicinity of the Connecticut River Valley.

Factor conditions depend on the workforce availability of skilled workers and the necessary technology knowledge. As told in the history of precision manufacturing, the skilled labor force needed for this type of work has been in the Connecticut River Valley since the late 1700s. Many of the interviewed shops stated that the availability of the workforce was crucial to the survival of their business. Similar to the workforce, the knowledge of precision manufacturing has also been in the Connecticut River Valley for a major part of its history. New innovations occur in this cluster because of competition between companies. For example, one of the largest companies that was interviewed explained that the competition fueled the new technological advances because the only way to offer lower prices to customers is to find new ways to streamline the existing manufacturing process. The floor manager went on to explain that the only way to beat out a competitor is to continually improve. The same sentiment seemed to be echoed throughout the rest of the interviews, showing how important innovation is to the precision manufacturing shops in the Connecticut River Valley.

The precision manufacturing shops that are grouped in the Connecticut River Valley can be classified as a cluster as the above paragraphs describe according to Michael Porter. This cluster

was also considered such by many of the owners interviewed because of the proximity of so many shops that do similar work, the other industries that help and complete the precision work, and the long history of its existence. Some of the other owners asked what the definition of a cluster was and when told Michael Porter's definition, many agreed that the Connecticut River Valley did in fact make up a cluster.

Drawing upon Porter's Diamond and Michael Porter's definition of a cluster, the precision manufacturing industry does constitute a cluster because of the connections and conditions above but also because of how many organizations and associations have been created in the Connecticut River Valley supporting the industry. The Regional Employment Board of Hampden County has a strong program focused on education surrounding the precision manufacturing trades. The Western Massachusetts National Tooling and Machining Association, the Precision Manufacturing Regional Alliance Project, and the Advanced Manufacturing Collaborative all operate in the Western Massachusetts region and all focus on advancing the field of precision manufacturing. There are many other organizations along the Connecticut River within this study area, from the Brattleboro Development Credit Corporation to the Connecticut National Tooling and Machining Association; it is obvious that this industry has been well recognized by state and local organizations.

Another aspect of a cluster is the connections between the main industry and the supporting ones. For example, precision manufacturing in the Connecticut River Valley and Westfield, Massachusetts is supported by material suppliers, polishers, de-burring, heat treatment, and other finishing companies, as well as the manufacturing companies who buy the finished products. Not only does this area make the precision manufacturing parts, but the same area supplies the metal needed, has the supporting industries needed to make a part complete, and in many cases the

ultimate buyer of the finished piece is located in close proximity. Specific to the Westfield, Massachusetts locations that were polled, most of their "raw materials" or bar stock metal was bought from local suppliers, many of which were in the Southern New England area. Many of their manufactured parts were shipped to other treatment shops and sometime to larger machine shops before they were considered finished. Most of the smaller locations in Westfield, Massachusetts sent their finished pieces to larger locations in the area to be put into more complicated equipment. The dependence of shops on each other is important in a cluster. Many of the larger shops sent their finished pieces to a multitude of places, depending on how many different projects were being worked on at once. When ultimately deemed finished, they were usually sent to the Connecticut area to one of the aerospace manufacturing locations. Some of the finished parts went further and traveled to some of the locations where the Department of Defense has planes, jets, and other machinery built. These local connections point to the industry being a cluster, because of the connections between suppliers, finishing shops, and buyers.

Precision Manufacturing in Westfield, Massachusetts

Westfield, Massachusetts has over 30 precision manufacturing shops within its borders. Twenty five of these shops were contacted by mail for interviews and nineteen responded and were interviewed in person. The following companies were interviewed:

Millrite Machine Company

Advanced Manufacturing

Berkshire Industries

Peerless Precision Incorporated

Paragon Manufacturing

LPI Incorporated

Pride Machining

Precise Turning and Manufacturing

Pond Brook Machining

Parkway Machining

Axis Precision

G and H Manufacturing

Vector Tool and Dye

Quality Machining Company

Westfield Tool and Dye

TNT Manufacturing

B and E Manufacturing

Ben Franklin Manufacturing

Marox Corporation

The following individuals were interviewed:

David Cruise, from the Regional Employment Board

Omer Gingras from the Western Massachusetts National Tooling and Machining Association

Eric Hagopian from the Western Massachusetts National Tooling and Machining Association

Other interviews were done; a full list can be seen in the bibliography.

Research Findings

Precision Manufacturing Owner Interviews

The questionnaire given to shop owners along with the most typical answer is below. Many of the questions had similar answers from most of the companies interviewed and of the six questions listed; the most popular answers are listed.

1. How satisfied are you with your current site and how the city helps/hurts you, would you chose Westfield again? (water, sewer, fiber optics, inspectors)

   Most people said that Westfield is a good place for business, about half owned the building and half leased or rented their space. The majority of people said they would choose Westfield again if they were forced to relocate.

2. Do you share information or knowledge with surrounding shops? Or do you keep away from sharing?

   The answers to this question were extremely varied, some responders said they do not share anything, some subcontract out work when they get too busy, and some are close with other shops and share information.

3. Where do you get your new employees from and where are they typically trained?

   Most shops hired people by word of mouth, usually they advertise in the paper but end up hiring someone who was recommended by another employee or friend.

4. How many employees do you have? Average age of your employees?

   Anywhere from 1 to 152 employees and the average age was about 40.

5. Where do your supplies come from? (foreign, domestic)

All stated that they would chose domestic materials over foreign, and most buy from New England metal dealers. It was also mentioned multiple times that all Department of Defense contracts required all of the materials to be made in the United States.

6. Is there anything you are not satisfied with in terms of location, interaction with city, customers, employees etc?

   The answers to this question were so varied all of the answers are listed below.

- Would like to expand but needs help from the city.
- Westfield Gas and Electric could provide incentives and help when upgrading equipment.
- Needs tax breaks, help from the state for training
- Grants need to be easier to apply for smaller businesses, need an intern to do grant applications, larger companies get the training grants because have the staff to fill out grants.
- Wants a streamlined process for expanding and a streamlined incentive process
- Would like tax breaks and to find a way to buy the building currently leasing in.
- Not looking to expand but are looking to evolve and improve.
- Asked why aren't grants advertised to small companies? The grant information should be easy to access and apply.
- Would like to get help with low interest financing
- Wants Westfield Gas and Electric to pay the Energy Saver Rebate.
- Would like there to be a more involved economic board, to have someone come to them and help with grant information and help with possible expansion.
- Upset that were forced to join the Westfield Business Improvement District
- Would like help with financing to build a new building/move to bigger location.

- Massachusetts is harmful to small business, unemployment process is tedious and expensive,
- The REB needs to make the possible grants, rebates, and evening classes more known to all shops.
- The issues with the industry are perception, cost of energy, and access to capital. Perception issues can be changed is there are tours of shops with parents before students chose their vocational path.
- Western Massachusetts is trying to share the current model of precision manufacturing nationally.
- Skilled labor is an issue, there are always 2-4 positions open for skilled people.
- Needs lower taxes, cheaper health insurance, a better skilled workforce, and better public perception of the trade.
- The REB reached out by email, a survey that asks what type of training shops need. The only reason they received an email is because went to a workshop at Savage Arms, where only 3 other shops attended. So wonders if only a few shops are getting these surveys, and if so how is that representing the interest of all?
- Is skeptical of this grant money, is it helping all shops or just large ones?

Western Massachusetts National Machine Tooling and Machining Association Head Organizers Interviews

The following questions were asked of three "association heads". One is the owner and manager of a precision manufacturing shop, one works for the Regional Employment Board of Hampden County, and one is a former owner of a precision manufacturing shop who is still involved with the industry.

1. How many precision manufacturing firms are there in Western Mass?

   - About 290, range from 2-3 people to Smith and Wesson, the average is about 38-39 employees.

2. In your opinion, does the precision manufacturing industry have a future in Western Mass?

   - Very much so. As good as any in the country.

   - The area has the lions share in aerospace and defense, created through the Defense Department. There is the history of the armory and the air craft innovations in Western Mass and Northern CT in the 1940s- Pratt and Whitney etc. As bigger shops have failed, they have created smaller shops, such as American Bosch, where workers created their own small shops, the workforce did not move, the company did. There is a skilled workforce in Western Massachusetts; there is a lot of training going on. There is a higher concentration of vocational schools, so the skilled labor force will perpetuate. In general the defense market has gone up since the Civil War, and commercial aircraft currently has a bigger back log than ever before.

Defense contracts plus the commercial airline back log= sustainability and growth, the only limiter is the skilled labor issue. If there are not enough workers, the jobs will move somewhere else.

-Dependent on the economic changes and aerospace and the Department of Defense, some shops are looking into medical now

3. What are the assets of Western Mass?

   - 91, 90, Bradley, Westover, Barnes, CT River, Knowledge Corridor second only to Boston area for Colleges, low cost of living (especially relative to south of Hartford and Eastern Mass), manufacturing history rivaling anyone, existing infrastructure (precision machine shops and the supporting industries), best K-12 schools in the country (Massachusetts), etc.

   - Overseas reshoring initiative. There has been a massive move to go overseas (China) in LLCs because it is cheap but there are no intellectual property laws, they steal everything, the workforce has now made up a middle class who are demanding higher pay and a better work place, so costs have gone up. Benefits of doing work there are reduced, risk vs. reward. High costs and low quality, lead time, and intellectual property risks are reasons why reshoring is taking place.

   - In a company's eyes there is a workforce here, it is more skilled verses the rest of the country. The geographical location is important the area has highway access, Logan, Bradley, and railways. The quality of the workforce is important. Has not seen cost of doing business to be a problem, they seem to have the support of banks.

4. What are the problems with the region?

   - Purely political…Taxachusetts, Hampden County is a welfare haven.

- The skilled workforce pipeline, the cost of doing business in MA or New England, climate. The region needs more training and education. There are not a lot of other threats, but OEMs are looking for more, they don't just want a piece, they want the piece totally finished.

-Some problems are the high cost, the concern over the future of workforce, they have to steal workers from each other, there is not enough career promotion, and there is a bad perception of the job. Lack of qualified young people, the workforce is aging. There is a perception issue as well.

Industry problems- Companies are controlled by the OEMs, they make parts not full products. The OEM supply chain is shrinking, not expanding.

To stay alive, the precision manufacturing industry needs to:

1. Stay innovative and abreast of new technology

2. Strategic planning, continue to look out 5+ years

3. Need quality certifications, some small firms don't have them but it will hurt smaller firms because it costs money to get, but without the quality standards it could hurt small businesses.

There is a shrinking supply chain, there is less demand. During the recession the large companies pulled work back from small company contracts, caused ripple effect down the chain.

5. If you could change anything about the region for the benefit of the precision manufacturing industry, what would you do?

- Continue changing the perception of manufacturing as a career. It has to start with the parents and the guidance counselors all the way to 8th grade.

- Increase education and awareness, getting parents and guidance councilors to understand the industry. Kids are just out of high school and making $15 per hour which is $700 per week. The region needs to change the way public is made aware of jobs, and make sure people understand manufacturing.

- The region is supportive, economic development, planners, legislators.

6. How can the government (state and local) help eliminate constraints on the growth of the precision manufacturing in place now?

   - Eliminate some if not all of MCAS requirements at trade/voc schools. Who cares what a sonnet or iambic pentameter is when one is machining an aerospace part worth thousands of dollars and has hundreds of lives in its hands?

   - Cost of business, pipeline of people

   - Cost of healthcare, unemployment insurance (state), electricity costs, need to continue to channel money into the Valley to allow the workforce to continue to be trained.

7. Do you consider the precision manufacturing shops currently in place in Western Mass to be a cluster? (cluster- a group of similar industries working in the same area, sharing information sometimes)

   - Absolutely. Our association is a good example of it. Perfect-no; good-yes. We all want the "pie" to be bigger for all of us.

   - Yes, but the shops lack the ability to share with one another, more collaboration would help.

8. If so, does the local government recognize this cluster and the benefits of the cluster?

   - Only recently, yes. They have been supportive. They need taxpayers.

   - Yes, state government recognizes, have given money to REB

9. How could a planner or economic development department encourage a precision manufacturing shop to locate in their city?

   - Lower taxes, good voc-tech schooling (see Westfield…) Cuts both ways, businesses open their wallets to support initiatives that benefit them.

   - "natural resources" people and cluster resources, could give tax benefits, which they have not done a good job of so far.

10. What would a state of the art precision manufacturing shop look like to the owners of shops here in the Valley? Or where can I find information about this?

    - Hoppe Tech in Chicopee, Tell Tool in Westfield, B & E in Southwick are all top-notch facilities.

    - Hoppee Technologies, Advanced, Berkshire, Millrite, J and E, B and E, WGI have new manufacturing technology blended with traditional manufacturing in a clean organized, well lit and well laid out facility. Security is always an issue, ITAR, everything is supposed to be locked and controlled, safety, need for better fire exits and sprinklers, it is just not economically feasible to build new.

11. What drives you crazy about shop owners? Why?

    - Nothing. All I know are ethical. I'm sure there are some bad apples as in any business.

    - Unwillingness to collaborate with others, they just don't see the value in it. Knows that collaborating has made self more successful, just need free advice but both sides need to share.

12. What type of education programs are in place? Or training assistance?

- Fortunately quite a few. Voc-tech schools, STCC, Asnuntuck in Enfield, new "Pathways to Prosperity" with West Side and STCC, free courses for employees at STCC.

- Incumbent employees- vocational high schools, STCC and companies hold training sessions in September and January, short courses a 20 hour 8 week course where the employee would get college credit in 12 to 14 different courses. There are 6 courses a semester with 45 seats in each.

Every 2 years there is a 40 hour program for managers and supervisors for people who went from machinist to manager. They need training to motivate workforce and evaluate workforce, Employers Associations of the Northeast.

Under employed individuals- veterans, career changers, out of school youth, and diversity (women) there are tax credits for shops who hire veterans, there is a workforce training fund that funds employers to pay for current workers.

There is a new Pathways to Prosperity program at West Springfield High School. This is an advanced manufacturing program for high school students. It is run in a CAD lab, started this past September with 40 kids in 9th grade. The program is partnered with local companies to offer summer internships and jobs, industry aligned curriculum, and some students may move to STCC for an associate's degree.

13. Are there unions in any precision manufacturing shops?

- Hopefully not. That's what killed Detroit.

- One in Springfield, Hancock Machine

14. Is there a legislative agenda for the industry in Washington? Boston?

- NTMA and PMA has “One Voice” in Washington and we (WMNTMA) have ourselves. Now that we have it, I attend every ribbon-cutting and presentation and continue to bend any and everyone’s ear as to the importance of workforce development.
- In Washington there is the Franklin Partnership, Omar Nashashibi and John Guzik. In Boston there is the Advanced Manufacturing Collaboration.

Summary and Recommendations

Implications for Policymakers

The importance of the precision manufacturing cluster in the Connecticut River Valley is obviously understood by the state of Massachusetts and the city of Westfield. The former governor of Massachusetts recognized the cluster and currently, the amount of money given to the Regional Employment Board programs shows the importance to the current administration. The city of Westfield has shown interest in helping various companies that have approached the municipality, proving that the city sees the importance of keeping these shops within its boundaries. Westfield was chosen as a case study to show how many precision manufacturing shops are in the Connecticut River Valley. If each municipality within the Connecticut River Valley understood how important these shops are, the cluster may be able to grow. Both local and regional economic development and planning offices need to understand this cluster in order for it to grow.

The below recommendations will help sustain as well as grow the precision manufacturing cluster in the Connecticut River Valley, using Westfield, Massachusetts as a case study.

Recommendations to Strengthen the Precision Manufacturing Cluster

The following recommendations should be given to not only the Regional Employment Board and the Western Massachusetts National Tooling and Machining Association, but also the Precision Manufacturing Regional Alliance Project and the Advanced Manufacturing Collaborative. These organizations will be referred to as the "associations" in the following recommendations:

1. The Regional Employment Board (REB) and Western Mass National Tooling and Machining Association(WMNTMA) need to actively seek out precision manufacturing companies to let them know what help is available rather than passively waiting for a company to contact them.

   Many of the owners interviewed were not aware of any of the help both of these organizations can give. Although the REB is involved in all types of employment in the region, their newly appointed director, David Cruise has been involved with advancing the precision manufacturing cluster in the past. The REB needs to continue to focus on advancing the precision manufacturing cluster actively instead of waiting for the owners to approach them. The WMNTMA also needs to actively seek out new members to join the association instead of continuing to exist and operate with the same limited number of members.

2. The Associations should provide at least 10 hours of technical assistance to each precision manufacturing company in the area.

   Both organizations should work together to provide each precision manufacturing shop with technical assistance however the company needs it. Some companies could need help applying for grants for training or other new equipment purchases and others might need help with filling out paper work to get students from the vocational schools to intern with them. This free technical assistance will help each precision manufacturing shop to

advance themselves and their employees. This will help the precision manufacturing cluster as a whole to grow.

3. The Associations should visit each precision manufacturing shop in person at least once a year, instead of emailing.

   Similar to the previous recommendation, the above listed Associations should visit each company in person at least twice a year to check in and ensure that the company's needs are being met. Many of the owners stated that they would like to be involved with the WMNTMA but they do not have the time to leave the shop for the afternoon to go to meetings. If the head of the association can make a personal visit to the shop, many problems that currently go unattended could be solved. If some problems are solved by these personal visits, the precision manufacturing cluster will be able to grow.

4. The WMNTMA should hold meetings in locations and at times that are easily accessible to owners and workers.

   Similar to the above recommendation, the WMNTMA needs to hold their association meetings in a location that is more central for the precision manufacturing shops. Meetings could take place in the shops themselves, which would be more convenient for the owners. Holding meetings at different times of the day could also help increase attendance at meetings, as some of the smaller shops do not have the option to leave during the day.

5. The WMNTMA needs to reach out to all precision manufacturing shops in the area once a year to increase attendance and membership.

In order to increase membership and participation with the WMNTMA, the organization should actively contact every precision manufacturing shop yearly which could help remind shop owners and managers of the importance of membership.

6. The state of Massachusetts, working with all of the above associations, needs to increase the number of grants available for upgrades with new machines with new and improved technology.

   Owners made it clear that they want to expand and buy more energy efficient and better quality machines. Many of the shops in the Connecticut River Valley are smaller, under 30 employees, could have trouble paying for a brand new machine, even with loans, so some type of grant program can help not only the individual companies, but would help train the workers on new machines, making them more versatile.

7. Municipally owned electric companies should offer incentives for the purchase of new energy efficient equipment, possibly subsidized by the state.

   Western MA Electric Company (WMECO) offers money back on purchases of new energy efficient equipment and also offers incentives that will pay the difference in a new machine when there is a more energy efficient model offered. First, the municipal electric companies should try to pay incentives for the purchase of energy efficient equipment like air compressors that is advertised in most stores, the Energy Saver Rebate. For example, one owner knew of a situation where a shop was looking to buy a new machine with two models available, the base model and a much more expensive energy efficient model. WMECO worked with the company to buy the more energy efficient model and paid the difference between the two models. Municipal electric companies might not have enough capital to offer this same deal, but increasing the amount of energy efficient

machines is important, so working with the state or even the federal government to find grant opportunities would be important.

8. The WMNTMA and the REB should work to create a grant writing assistance program where students learn how to write business grants while helping small companies.

   This type of program will help both students and the machine shops. Smaller shops may want to apply for various grants but do not have the time or man power to complete the process. Students will learn how to write the grants by working with the REB and their university, and the WMNTMA can connect the students with the companies in need.

9. The Western Massachusetts Economic Development Council should discuss how local policy can help sustain and grow the precision manufacturing cluster.

   Local and county economic development policy should address the precision manufacturing cluster. The importance of the cluster needs to be emphasized from the local to the federal level, as this industry and its ancillary industries employs many people in the Connecticut River Valley.

10. The City of Westfield's economic development and planning offices should work together to help precision manufacturing shops grow. These departments need to ensure that the precision manufacturing industry is mentioned in Master Planning documents as well as other economic development documents, as they are not now.

    These city agencies should meet with precision manufacturing shops and assess what their needs and wants are. Many companies stated that they would like to expand but would need TIF's or tax increment financing in order to do so. The offices should create a streamlined and simplified process for obtaining this type of help.

11. Vocational and traditional high schools should let students and parents tour a precision manufacturing shop prior to the student choosing a trade.

    Breaking the perception issues involved with precision manufacturing has proven tough to do, but if parents supported their child's interest in manufacturing more students would chose the trade and the industry would grow. Manufacturing has a perception of being dirty and dangerous, but the precision manufacturing work is the opposite. Erasing this perception is a huge roadblock for the industry, but once it is broken many more people, both young and older may be interested. This increase of workers may be what the precision manufacturing industry needs to survive in the Connecticut River Valley.

Appendix

Interview questions presented to shop owners:

1. How satisfied are you with your current site and how the city helps/hurts you, would you chose Westfield again? (water, sewer, fiber optics, inspectors)

2. Do you share information or knowledge with surrounding shops? Or do you keep away from sharing?

3. Where do you get your new employees from and where are they typically trained?

4. How many employees do you have? Average age of your employees?

5. Where do your supplies come from? (foreign, domestic)

6. Is there anything you are not satisfied with in terms of location, interaction with city, customers, employees etc?
7. What could Westfield's economic development department do to help your business?
8. Any other comments?

Interview questions presented to WMNTAMA heads:

1. How many precision manufacturing firms are there in Western Mass?
2. In your opinion, does the precision manufacturing industry have a future in Western Mass?
3. What are the assets of Western Mass?
4. What are the problems with the region?
5. If you could change anything about the region for the benefit of the precision manufacturing industry, what would you do?
6. How can the government (state and local) help eliminate constraints on the growth of the precision manufacturing in place now?
7. Do you consider the precision manufacturing shops currently in place in Western Mass to be a cluster? (cluster- a group of similar industries working in the same area, sharing information sometimes)
8. If so, does the local government recognize this cluster and the benefits of the cluster?
9. How could a planner or economic development department encourage a precision
10. What would a state of the art precision manufacturing shop look like to the owners of shops
11. What drives you crazy about shop owners? Why?
12. What type of education programs are in place? Or training assistance?
13. Are there unions in any precision manufacturing shops?
14. Is there a legislative agenda for the industry in Washington? Boston?

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Interviews done through e-mail, October 15, 2012 -November 20, 2012

Omer Gingras-Owner of C and G Machine and part of the Western Massachusetts National Tooling and Machining Association

Gary J. Masciadrelli- Department Chair of Mechanical Engineering Technology, Springfield Technical Community College

Clement Fucci- Manufacturing Technology Department Chairperson, Westfield Vocational High School

Michael Graney- Senior Vice President of Business Development, EDC of Western Massachusetts

Glenn Ford-President, B&E Precision Aircraft Components