The manufacturing environment is changing dramatically, and the technologies and the skills to use them are becoming critical to the success of manufacturing companies. This report highlights the necessity for multiple stakeholders to work together to yield an impact on the supply of well-trained workers.

We are now at a turning point in the manufacturing workforce environment in North America. There are major changes underway in the demand and supply for manufacturing workers – many driven by new technologies – that will require new strategies and tactics for both companies and employees. These changes could lead to some of the most dramatic shifts in the human aspects of manufacturing since the Industrial Revolution. Indeed, some elements of this shift are already taking place, including the demand for a new type of technology-intensive manufacturing workforce and the limited availability of that workforce. This report is the first in a series of related reports on the new manufacturing workforce, with a particular focus on manufacturing technology. This first report describes the current situation in the manufacturing workforce for North America. It also summarizes the results of a survey of manufacturing managers on these issues. Subsequent reports will address the following topics:

- The Rise of the “Tech” in Manufacturing;
- Contemporary Manufacturing Technologies and the Talent Required to Use Them;
- Approaches to Educating the Manufacturing Workforce on Technology;
- Policy Prescriptions for the Manufacturing Talent Gap.

Changes in Demand for the Manufacturing Workforce

Perhaps the most significant development in the demand for North American manufacturing workers is that the U.S. and Canadian governments, the business media, universities, and other institutions have arrived at a consensus that manufacturing matters to the economy’s and the society’s well-being. For many years it was argued that North America was heading for a “service economy,” and few observers worried about the movement of high-tech and other manufacturing jobs to other parts of the world. This trend amounted
to a loss of 5 million manufacturing jobs between 2000 and 2010.1 Less than 10 percent of the U.S. workforce is currently employed in manufacturing, down from a peak of 30 percent in 1960, and 14 percent in 2000.2 Similarly, Canada lost one in seven – a total of 322,000 – manufacturing jobs between 2004 and 2008 alone.3 The United States still added 24 percent of global manufacturing jobs in the world economy in 2011, and Canada added an additional 1.5 percent.4 The global percentages for both countries, however, have been declining over several decades, and only a major effort can reverse the trend.

These dramatic declines in North American manufacturing may have put manufacturing occupations in a negative light for an entire generation entering the workforce. However, they also had one positive effect: they eventually led to the belated recognition that manufacturing jobs are critical to a prosperous middle class. The near-death of the U.S. automobile industry during the 2008-9 financial crisis also helped catalyze attempts to revive North American manufacturing.

Our survey results below suggest that North American manufacturing managers believe that onshore manufacturing will be increasingly important in the future, and there are occasional high-profile announcements of onshore manufacturing initiatives by companies such as Apple. However, to restore the manufacturing industry on U.S. and Canadian soil, companies, governments, and educational institutions all need to make more of a commitment to manufacturing talent development.

There is also an increasing awareness that in order for domestic manufacturing to prosper, a different set of skills is necessary to meet companies’ current needs. Despite an anemic economy overall and weak employment growth in the U.S. economy, there are as many as 600,000 unfilled manufacturing job openings in the U.S. alone, according to a joint study by Deloitte and the Manufacturing Institute.5 Most of these jobs are for skilled production workers in roles like machinists, operators, craft workers, distributors and technicians. These jobs require extensive training and are difficult to fill. The unemployment problem is less apparent in Canada because of the natural resources boom there, but Canada has a similar shortage of skilled manufacturing talent.

The Deloitte/Manufacturing Institute study included a survey of manufacturing executives, who expressed concern about the workforce skills gap. Seventy-four percent of the survey respondents reported that workforce shortages or skills deficiencies in production roles are having a significant impact on their ability to expand operations or improve productivity. When the respondents were asked to look ahead three to five years, they ranked access to a highly skilled, flexible workforce as the single most important factor in their effectiveness – ranking it 20 percentage points more important than other factors such as new product innovation or increased market share.

Due to the aging North American workforce and a lack of younger talent to fill the pipeline, a generational skills gap also exists in manufacturing. Because of declines in domestic manufacturing, productivity gains, and a weak economy, many companies have hired few manufacturing workers of any type over the last couple of decades. As a result, many existing employees are nearing retirement. At Boeing, for example, 28 percent of the company’s employees are older than 55 and eligible for retirement. This generational shift will lead to even greater demand for new manufacturing workers for the jobs that remain.

Compounding the problem is that the nature of manufacturing jobs has changed dramatically over recent decades because of new technologies. Many manufacturing technologies – computer numerical control (CNC) machine tools, computer-aided design and manufacturing (CAD/CAM) programs, robotics, and cell-based manufacturing
networks – are all heavily computer-based. These are complex technologies, and programmers and operators of them require substantial technical training.

Computers and microprocessors not only control the detailed movements of machinery, but have also taken over the control and flow of manufactured goods through the entire process. Automated process control systems and robotics have, of course, been partially responsible for the reductions in manufacturing workforce levels (and improvements in productivity). But the remaining workers who can maintain and modify these complex automated systems need high skill levels. There may be only half the jobs for the manufacturing workforce in environments of high automation, but the workers in those jobs may have to be twice as skilled.

In addition to the need for technical and process automation skills, manufacturing workers are increasingly taking on traditionally management-oriented activities in the manufacturing process, including efforts to improve quality and address production bottlenecks. Diana Tremblay, Global Chief Manufacturing Officer at General Motors, noted her impressions of line manufacturing workers at the new Chevrolet Sonic plant in suburban Detroit at a Massachusetts Institute of Technology conference:

"[In this plant] it is difficult to tell who is management and who is labor, who is working on the shop floor and who is the plant manager. Everyone is solving problems, doing fishbone diagrams, etc. I can’t tell the difference."

In short, the demand for manufacturing workers is increasingly a demand for well-educated knowledge workers. Most companies today are not recruiting for manufacturing talent as if they were knowledge workers, and are not managing them as a knowledge workforce either. Treating manufacturing workers as knowledge workers promises considerable change not only in recruiting and retention practices, but also in labor/management relations, the role of unions, and other aspects of the work model.

Promising but Insufficient Changes in Supply

To cope with all these changes in the demand for skilled manufacturing talent, the supply factors for such workers need to change and expand dramatically. Indeed, there are impressive examples of programs of various types to develop workers with the necessary skills. The problem is that these programs are fragmented and limited in scope. In North America there is no equivalent, for example, to the well-established and pervasive German vocational training system, which mixes training, apprenticeship, and the accumulation of work experience. This system has been critical to the continued success of the German manufacturing sector.

There are, of course, limited existing programs that are worthy of emulation on a larger scale.

Some German companies with operations in North America have imported some of the vocational training practices that are popular in Germany. Siemens, for example, has a program that President Obama mentioned in his 2012 State of the Union Address:

Jackie Bray is a single mom from North Carolina who was laid off from her job as a mechanic. Then Siemens opened a gas turbine factory in Charlotte, and formed a
partnership with Central Piedmont Community College. The company helped the college design courses in laser and robotics training. It paid Jackie’s tuition, then hired her to help operate their plant.⁹

There are also other German companies that have imported manufacturing talent development programs. BMW, for example, has also created its own educational programs for advanced manufacturing skills in its South Carolina operations.

Other companies, regions and manufacturing industries have created their own skill development programs. Wichita, Kansas – a center for aircraft manufacturing – has created the National Center for Aviation Training in conjunction with Wichita Area Technical College to train aircraft manufacturing workers in new technologies. Similarly, the Automotive Manufacturing Technical Education Collaborative (AMTEC) aligns a set of community colleges in states with automobile manufacturing with Ford, GM, and Toyota representatives, and several auto component manufacturers. Rolls-Royce has an extensive apprenticeship program that encompasses its factories in the U.S. and Canada.

Certification of skills is also an important component of ensuring a supply of trained and capable workers. There are some efforts underway to develop certifications for particular manufacturing skills. The Manufacturing Institute is deploying the Manufacturing Skills Certification System endorsed by the National Association of Manufacturers (NAM). The Obama administration is attempting to certify veterans for manufacturing-oriented skills acquired during military service.

Each of these programs appears impressive, but all are piecemeal and small relative to the need. Few are national in scale or broadly implemented across the U.S. or Canada. It is unlikely that they can address the scope and nature of the manufacturing skills gap without considerable expansion or modification. It seems likely that there would need to be national government action or support for such expansion, and in the current political climate (at least in the U.S.), this seems unlikely.

Even if government and educational institutions mobilize to create more high-skilled manufacturing workers, there is another issue with the supply of workers that must be overcome. Large-scale layoffs, the use of labor arbitrage through offshore outsourcing, and the decline of labor union power and influence have all contributed to a distrust of the long-term intentions of manufacturing companies. In addition, many North American companies seem to feel that it is no longer their role to educate workers. If individuals’ trust that a manufacturing career can be stable and rewarding over the long term is to be restored, companies will have to both invest in their workers in the present, and reassure them about their future prospects.

Connecting Demand and Supply

There do exist, of course, short- and long-term mechanisms that can connect the supply and demand for high-skilled manufacturing talent. Longer-term approaches such as better training programs and government policies will be described in other reports in this series. In the short run, some of the following steps would be useful:

- A vendor-independent taxonomy of key manufacturing technologies, applications, and related skills;
- A national or even international directory of jobs in manufacturing technology;
- A similar directory of educational offerings in manufacturing technology;
- A variety of internship programs providing an introduction to manufacturing and manufacturing technologies;
- Programs allowing students and prospective employees to tour and observe manufacturing technology environments.

Some of these proposed initiatives would allow workers who already have the relevant skills to find and take jobs that use those skills. Others would simply motivate students and potential employees to acquire the needed skills.
Survey Results
In order to assess perceptions of these issues, Manpower conducted a survey of 353 North American manufacturing managers in the summer of 2012. The topics of the survey included the companies’ needs for skilled manufacturing workers, and the changes that are taking place in technologies for manufacturing and related skills. Substantial majorities of the respondents agreed with most of the survey questions, as seen in Tables 1 (Manufacturing Talent Survey Question Results) and 2 (Manufacturing Technologies and Skills Survey Question Results).

- The respondents were highly likely (over 90%) to agree that companies that successfully build a skilled workforce will be among the most prosperous in the future, that onshore manufacturing in North America will be increasingly critical to their operations, and that obtaining workers with the needed skills is critical to the success of onshore manufacturing.
- Over 90% also agreed that they view their manufacturing workers as knowledge workers, and that they are full partners in solving problems, improving processes, and satisfying customers.
- Over 80% agreed that they struggled to get the talent they need for manufacturing, and over 70% agreed that the talent gap issue is increasing in severity now and will continue to do so.
- Almost two-thirds (64%) agreed that their manufacturing processes require higher levels of skills than in the past.
- A minority (37%), however, went so far as to agree that the lines are blurring between management and labor in terms of technical skills and knowledge.

The survey respondents also voiced support for the perception that manufacturing technology is changing dramatically, and that workers need training to master it. About four out of five manufacturing managers in the survey agreed that educational institutions needed to do more to educate workers on manufacturing technologies, that their manufacturing processes increasingly generated data that needed to be analyzed, and that their manufacturing technologies were increasingly computer-based (and hence required more computer-oriented skills). More than 70% agreed that manufacturing processes were becoming more sophisticated and complex, and that certification in manufacturing technology skills was needed. Just under a majority (49%) agreed that “big data” would lead to competitive advantage in manufacturing, although a large percentage (39%) answered “not sure” to the question, suggesting a lack of familiarity with the concept of big data.

Manpower Manufacturing Workforce Survey: Table One – Talent Results
% of respondents (N=353) stating they “strongly agree” or “agree” with statements

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<thead>
<tr>
<th>Statement</th>
<th>Percentage Agreeing</th>
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<tr>
<td>Companies that can successfully hire, build, and retain a highly skilled workforce will be those that prosper over the next decade.</td>
<td>96%</td>
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<td>I believe manufacturing in North America will be increasingly important to my company’s future operations.</td>
<td>93%</td>
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<td>The skills of the manufacturing workforce will be a key factor in whether manufacturing returns as a key American industry.</td>
<td>93%</td>
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<td>We increasingly view our manufacturing workers as knowledge workers.</td>
<td>92%</td>
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<tr>
<td>We view our manufacturing workforce as full partners in solving problems, improving processes, and satisfying our customers.</td>
<td>90%</td>
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<td>My company struggles to get the skills it needs in our manufacturing workforce.</td>
<td>81%</td>
</tr>
<tr>
<td>The problem of insufficient manufacturing skills is increasing in severity now and will continue to get worse over the next several years.</td>
<td>71%</td>
</tr>
<tr>
<td>The manufacturing processes we use require workers with higher levels of education or expertise than in the past.</td>
<td>64%</td>
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<tr>
<td>The division between management and labor in terms of technical skills and knowledge is blurring in our organization.</td>
<td>37%</td>
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Report One: Technology and the Manufacturing Workforce: An Overview

Manpower Manufacturing Workforce Survey: Table Two – Technologies and Skills Results

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<th>Statement</th>
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<td>Educational institutions in this country need to do a better job of educating the manufacturing workforce on new technologies.</td>
<td>84%</td>
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<td>Our manufacturing technology increasingly generates data that should be analyzed to create optimum performance.</td>
<td>81%</td>
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<td>Manufacturing technologies are increasingly computer-based, and require many of the skills to manage and operate as computers do.</td>
<td>79%</td>
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<td>There is a need for certification that workers have the needed skills to manage and optimize specific manufacturing technologies.</td>
<td>77%</td>
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<tr>
<td>The manufacturing process/technologies we use in our operations have become much more sophisticated and complex in the past several years.</td>
<td>73%</td>
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<td>Manufacturing will soon be an industry where &quot;big data&quot; is used to create competitive advantage. (Big data is data that is either too large or too unstructured to be managed through traditional means).</td>
<td>49%</td>
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Summary

There remains little doubt, then, that the manufacturing environment is changing dramatically, and that manufacturing technologies and the skills to use them are becoming critical to the success of manufacturing companies. It is not difficult to envision the tactics that would accelerate the development of high-technology manufacturing skills, and other mechanisms that would connect people possessing those skills with companies offering relevant jobs. What is more difficult to imagine is how companies, government organizations, universities and community colleges, and individuals themselves, might work together to yield the necessary impact on the supply of well-trained workers. If they do not, however, the revival of manufacturing in North America is at substantial risk.

9 President Barack Obama, 2012 State of the Union Address, January 24, 2012.

This report is part of “The Future of the Manufacturing Workforce” research paper.

About the Author:
Thomas Davenport is a business strategist and best-selling author that researched the manufacturing industry as it relates to workforce challenges on behalf of Manpower.

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