Ready for the Job:

Understanding Occupational and Skill Demand in New Jersey's Manufacturing Industry

Chemical Processing, Food Processing, Glass Production, and Printing and Publishing

A Report of the New Jersey State Employment and Training Commission

Prepared by the
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With the Assistance of the Workforce Investment Boards of
Bergen, Cumberland/Salem, Hudson, Mercer and Passiac Counties,
and Cumberland County College, Mercer County Community College, and William Paterson University

James E. McGreevey, Governor

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Preface and Acknowledgements

The *Ready for the Job* project was developed by the New Jersey State Employment and Training Commission (SETC) with the New Jersey Departments of Labor and Education. The project was directed by Henry Plotkin, Executive Director of the SETC, and was funded by the New Jersey Department of Education. The research was conducted by the John J. Heldrich Center for Workforce Development at Rutgers, The State University of New Jersey, with assistance from the local Workforce Investment Boards of Bergen, Cumberland/Salem, Hudson, Mercer, and Passaic Counties and from researchers at William Paterson University, Cumberland County College, and Mercer County Community College.

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Project Summary

Economic prosperity for New Jersey, its citizens and its businesses depends on a well-trained workforce. This joint effort of the New Jersey State Employment and Training Commission, the New Jersey Department of Education, and the New Jersey Department of Labor is designed to collect up to date information from employers on the skill needs of eight key industries in the state. The eight industries that are the focus of this effort are: health care, finance/insurance, construction, utilities/infrastructure, manufacturing, tourism/hospitality, transportation/logistics, and information technology.

The entire effort, led by the local Workforce Investment Boards of Bergen, Cumberland/Salem, Hudson, Mercer, and Passaic Counties and guided by Industry Advisory Groups, involved over thirty focus groups and eighty interviews with employers and educators. The Heldrich Center for Workforce Development at Rutgers, The State University of New Jersey, with assistance from researchers from William Paterson University, Cumberland County College, and Mercer County Community College, conducted this research to identify the skills, knowledge, and educational requirements of seventy-four select occupations and eleven areas of work. The Heldrich Center and its research partners also identified the key trends in each industry that affect skill requirements and identified strategies for meeting the key workforce challenges of each industry.

The information collected through this effort will be disseminated through this series of reports and through an Internet website (www.njnextstop.org) that will include a searchable database of each profiled occupation. This information will assist a variety of users. Students and job seekers can use this information to make decisions about education and careers. Educational and training institutions can use this information to develop course and programs of study that will provide individuals with necessary skills. Policy makers at the state level can use this information to ensure that government resources are invested in programs and efforts that will benefit individuals and businesses.

Understanding Occupational and Skill Demand in New Jersey's Manufacturing Industry

Executive Summary

The manufacturing industry in New Jersey employs over 460,000 workers and is the largest industry included in this study. One out of every ten workers in New Jersey is employed in manufacturing. However, the pace of job creation in the industry has slowed as a result of technological advances and the use of global labor markets that allow many companies to move jobs offshore. Employment projections indicate that jobs in the manufacturing industry will decline by 10% from 2000 to 2010. However, some high-tech "niche" sectors, such as scientific glass, have emerged as growth industries. Other sectors continue to have a strong presence in the state due to factors such as the availability of a relatively skilled workforce in New Jersey, the need for quick delivery to customers, access to the state's natural resources, and the state's proximity to major industrial markets.

Jobs in the manufacturing industry have undergone tremendous change over the last several decades. The growing sophistication of technology is impacting the industry's productivity and has changed the way much of the work is done in manufacturing facilities. Workers must possess the technical expertise to both understand underlying principles of the production process and interact effectively with advanced machines and computers to control these processes. Unfortunately, these changes and other factors have contributed to a growing gap between entry-level workers and the highly skilled technicians and managers needed to keep companies competitive in a global market.

This report focuses on four manufacturing sectors selected by the Workforce Investment Boards (WIBs) of Cumberland/Salem and Passaic Counties: food processing, chemical processing (except drugs), glass production, and printing and publishing. This report, based on focus groups and interviews that include over thirty separate employers, summarizes the skill, knowledge, and educational requirements of key manufacturing occupations within these four sectors and identifies strategies for meeting the key workforce challenges facing the industry.[1]

Skill Requirements of Selected Job Groups

The thirteen occupations selected for this study by the Industry Advisory Groups largely fall into four "job groups" that share a common set of core competencies, basic educational requirements, and skill sets. While within each job group the level of skill mastery required varies, the occupations within the job group share a common continuum of competencies and tasks. In a dynamic and fluid economy, the definitions and requirements of occupations change often and can vary from one employer to another. The organizing of occupations into job groups minimizes the effect of these differences.

Labor and Skilled Trades

The Labor and Skilled Trades job group includes both highly skilled and entry level workers who perform the "hands on" building, repairing, installing, and controlling of equipment and materials at a manufacturing facility. Mastery and precise application of a range of tools and materials is necessary to succeed in this job group, particularly as new tools and materials are introduced to the industry. In addition, the ability to understand and apply technology to manufacturing work is critical, as manufacturing facilities become more technologically complex.

Occupations: machinist, production laborer, stationary engineer, glass cutter and trimmer, glass grinding and polishing worker, instrument/electronics technician

Core Competencies	Sample Skills
Precise application of tools and materials.	Mathematics
Effective application of math concepts relevant to manufacturing.	Problem solving and critical thinking
Understanding of and adherence to safety precautions.	Equipment selection and maintenance
Knowledge and effective application of technology relevant to manufacturing.	Operation and control
Ability to think critically and solve problems encountered on the work site.	Installation and repairing
Ability to work as a team with multiple occupational sectors on a work site.	Reading comprehension

Management/Supervision

The Management/Supervision job group includes first-line supervisors and production managers, occupations endemic to all manufacturing sectors. Emerging skills in this job group include computer and other technology skills, as manufacturing facilities are becoming more technologically complex. In addition, today's workforce is move diverse than in the past, and cultural sensitivity is a skill that is becoming increasingly important. Managers must also stay abreast of evolving safety and security regulations.

Occupations: first-line supervisor and production manager

Core Competencies	Sample Skills
Use effective judgment and decision making to allocate resources and personnel to meet project budget and deadline.	Problem solving and critical thinking
Communicate and coordinate the efforts of multiple project partners, vendors, and workers to share common organizational goals.	Entrepreneurship and business skills
Understand and adhere to safety precautions with consistency.	Coordination
Provide technical leadership across projects/disciplines.	Communication and teamwork
	Monitoring
	Time management
	Management of personnel resources

Sales/Relationship Management

Sales people in the manufacturing industry not only sell products and services, they also develop and maintain long term relationships with customers and analyze customer needs on an ongoing basis. As technology increases productivity, new and more sophisticated products and production systems are being created faster than ever before. Therefore, sales representatives in this sector must be very adaptable and able to incorporate large amounts of complex new information into their communications with customers.

Occupations: sales representative

Core Competencies	Sample Skills
Provide superior customer service and use effective organization skills to provide the appropriate follow through.	Service orientation
Develop new customers through networking.	Communication and teamwork
Identify customer needs quickly and accurately and take actions to address those needs.	Systems evaluation
Target the appropriate products/services to market to a potential customer.	Problem solving and critical thinking
Apply advanced math, statistics, financial, and regulatory knowledge routinely and accurately.	Reading comprehension
Use technology effectively to complete tasks.	

Science and Technology Application

The Science and Technology Application job group involves the application and evaluation of technological and scientific processes. The education requirements of this job group vary, with many positions requiring a postsecondary degree. The emerging skills in this job group include advanced computer and technology skills, as well as advanced knowledge of and the ability to apply and follow increasingly complex safety and security regulations.

Occupations: chemist, inspector, food scientist/technologist, plant and system operator, industrial health and safety engineer

Core Competencies	Sample Skills
Apply knowledge of technology and science relevant to industry practices.	Operation and monitoring
Use tremendous attention to detail while working to identify and assess system flaws.	Mathematics and technology
Demonstrate an understanding of and a consistent adherence to safety precautions.	Equipment selection
	Analysis
	Reading comprehension
	Writing

Key Workforce Challenges

The manufacturing industry in New Jersey is facing three primary workforce challenges:

Challenge 1: Attracting and Recruiting Workers. Attracting and retaining workers with the skills needed to succeed in the industry is a constant challenge, due to increasing skill demands in some sectors and decreasing interest in the industry on the part of students and job seekers.

Challenge 2: Preparing Skilled, Qualified Workers. Employers report that workers entering the field do not have the skills needed to do their jobs effectively. With production processes becoming increasingly automated and run largely by computers, manufacturing employers are in need of highly skilled workers who can understand complex production processes and program computers to handle these tasks effectively.

Challenge 3: Upgrading the Skills of Current Workers. Technological advances in the industry make it necessary to train incumbent workers and provide them with the new skills they need to apply the new technology. Finding the time and the resources to provide this training is difficult for many employers, particularly small employers.

To address these challenges, the manufacturing industry must work with the public and the private sector, as well as educational institutions, to create and coordinate a comprehensive set of workforce development strategies. Recommendations for doing so must recognize the complex needs of this changing industry.

Recommendations

1. Recommendations to Attract and Recruit Workers

Increase Awareness of Careers in the Industry

The manufacturing industry must create better career education opportunities for students. Education, workforce development, and industry groups should work together to better educate students of all ages regarding the full range of career opportunities available to them, including careers in the manufacturing industry.

The industry should also coordinate existing efforts to develop an industry marketing strategy. This industry-wide strategy should provide high school students, guidance and career counselors, and the workforce development system with information on careers in manufacturing. This strategy must build on the efforts of trade unions, the New Jersey Department of Labor, and local business groups such as the Consortium for Manufacturing Excellence to recruit individuals to jobs in the manufacturing industry.

Recruit Workers from Untapped Labor Pools

Immigrants are a potential source of labor for the manufacturing industry, one that employers in South Jersey tell us that they have been slow to embrace. They stress, however, that they are a viable source of labor, particularly for lower-skilled, harder-to-fill positions.

2. Recommendations to Prepare Skilled, Qualified Entry-Level Workers

Strengthen Secondary Education

The New Jersey educational system must incorporate workplace readiness and basic skills needed in the workplace into school curriculums. Employers in this and other industries report that many entry level workers lack workplace readiness skills and basic skills that are necessary to succeed in nearly all jobs today. High schools should work to incorporate these key skills into the curriculum.

At the same time, the state and its schools must strengthen and reward occupational education. The public education system must strengthen the vocational technical (voc-tech) system and acknowledge its value in preparing students for careers.

3. Recommendation to Upgrade the Skills of Current Workers

The industry should use funds from the state's customized training program to support the development of new industry/education partnerships. The customized training program of the New Jersey Department of Labor provides matching grants to businesses and groups of businesses to provide training to their employees. A portion of the funds from the program should be used to strategically support industry/education partnerships to upgrade the skills of current workers in growth sectors of manufacturing.

4. Overall Recommendations

The manufacturing industry must continue to develop industry/education partnerships to address workforce challenges. Employers, educational institutions, and government must work together to prepare workers for the industry. The Glass Industry Collaboration of New Jersey (GICNJ), a partnership between Rowan University and several glass companies, provides a model for such partnerships. GICNJ should be expanded and the model exported to other sectors of the industry.

Reader's Note

Ready for the Job Identifies Four Skill Types

The *Ready for the Job* project identifies four types of skills that are required by or important to employers. Employers require basic skills and workplace readiness skills for nearly all jobs. Cross-industry demand skills, identified through the focus groups and interviews with employers, are important in a variety of occupations in many industries. Finally, employers require advanced technical and professional skills for many jobs. These skills are job-specific and are typically obtained through post-secondary education and training either provided by educational institutions or by employers.

Type of Skill	Definition	Level of Importance
Basic Skills	Ability to read, write, and perform basic mathematical calculations.	Criteria for most entry level or low-level or low-skilled types of jobs.
Workplace Readiness Skills	Minimum expectations for functioning in the workplace, that include meeting standards for attendance and promptness, reliability and integrity, as well as dress and decorum.	Criteria for all jobs in the workforce.
Cross-Industry Demand Skills	Broader skills sets that are in the highest demand among employers in today's economy, and indicative of success in the workforce. These cross-industry demand skills include: - Math and technology skills - Problem solving and critical thinking skills - Communication and teamwork skills - Entrepreneurship and business skills	Strength in these skill areas can lead to expanded employment opportunities and career success across industries.
Advanced Technical/ Professional Skills	Skills acquired through education and training needed to perform specific tasks and succeed in specific jobs.	Criteria for performance in specific jobs. Education and training is provided by post-secondary education institutions and /or employers.

[1] A full discussion of the methodology used for this study is included in Appendix A.
<http://www.southjerseyworks.info/counties/atlantic/partners.htm>

Understanding Occupational and Skill Demand in New Jersey's Manufacturing Industry

I. Introduction

Due to global macroeconomic trends and technological advances, manufacturing employment overall is in decline, yet manufacturers continue to employ significant numbers of New Jerseyans. The manufacturing industry in New Jersey employs over 460,000 workers and is the largest industry included in this study. One out of every ten workers in New Jersey is employed in manufacturing. However, the pace of job creation in the industry is slowing as a result of technological advances and the use of global labor markets that allow many companies to move jobs offshore. Further, employment projections indicate that jobs in the manufacturing industry will decline by 10% from 2000 to 2010. However, some high tech "niche" sectors, such as scientific glass, have emerged as growth industries. Other sectors continue to have a strong presence in the state due to factors such as the availability of a relatively skilled workforce in New Jersey, the need for quick delivery to customers, access to the state's natural resources, and the state's proximity to major industrial markets.

Jobs in the manufacturing industry have undergone tremendous change over the last several decades. The growing sophistication of technology is impacting the industry's productivity and has changed the way much of the work is done in manufacturing facilities. Workers must possess the technical expertise to both understand underlying principles of the production process and interact effectively with advanced machines and computers to control these processes. Unfortunately, these changes and other factors have contributed to a growing gap between entry level workers and the highly skilled technicians and managers needed to keep companies competitive in a global market.

This report focuses on four manufacturing sectors selected by the Workforce Investment Boards (WIBs) of Cumberland/Salem and Passaic Counties: food processing, chemical processing (except drugs), glass production, and printing and publishing. This report, based on focus groups and interviews that included over thirty separate employers, summarizes the skill, knowledge, and educational requirements of key manufacturing occupations within these four sectors and identifies strategies for meeting the key workforce challenges facing the industry.[2]

The participating WIBs convened two advisory groups of industry stakeholders to guide the effort.[3] The Cumberland/Salem advisory group, working in collaboration with each WIB in South Jersey (Atlantic/Cape May, Burlington, Camden, Cumberland/Salem, and Gloucester) selected three key sectors important to the workforce development of the region, including glass production, chemical processing, and food processing. The Passaic advisory group selected two key sectors, including printing and publishing and chemical processing. Together, the advisory groups identified thirteen key occupations within the manufacturing industry for in-depth skill demand analysis and provided input on research, focus group and interview participants, and recommendations. The Heldrich Center, Cumberland County College, and William Paterson University held six focus groups with industry and educational stakeholders regarding industry trends and the skill, knowledge, and educational requirements of selected occupations. The Heldrich Center also conducted fifteen interviews with industry human resource and management personnel regarding education, training, and recruitment issues.[4]

II. Profile of the Industry and Its Skill Needs

a. Background of the Manufacturing Industry and its importance to New Jersey

The manufacturing industry consists of many different types of production and includes workers employed in a wide array of occupations and settings. The entire American manufacturing industry, which accounts for 14.1% of the U.S. gross domestic product (GDP) and is responsible for producing goods of all kinds, is vital to both the national and New Jersey economies (see Figure 2.1).[5] At the same time, it occupies a unique position in the New Jersey economy; manufacturing as a whole is declining in the state (and the nation), but the pockets that remain are of significant importance to the economy. For example, in northern New Jersey, printing and publishing and chemical processing employ large numbers of people, while in southern New Jersey chemical, food, and glass manufacturers continue to be major employers.

Small companies are prevalent in the industry. Most of these companies occupy specialized niches that provide them with an essential marketing advantage. According to the National Association of Manufacturers, 58% of all manufacturing employment in New Jersey resides with small firms. This is especially true in South Jersey where many manufacturing employers have less than 100 employees.[6]

Food Processing

Nationally, in 2000, there were nearly 1.7 million individuals employed in the U.S. food processing sector. Occupations in this sector include: bakers, meat, poultry and fish cutters and trimmers, butchers and meat cutters, slaughterers and meatpackers, food batchmakers, food cooking machine operators and tenders, and food and tobacco roasting, baking and drying machine operators and tenders. Employment typically is held

in either large food processing plants or in retail establishments, such as grocery stores and bakeries.7 Food processing is one of the largest employers in South Jersey, particularly Cumberland County, where the top twelve food processing firms employ more than 2,200 people.8 Statewide, the industry employs more than 34,000 workers. While tomato processing historically was the areas largest food processing activity, it is no longer the mainstay it once was in the county. However, close proximity to New Jersey's farmers helps to maintain fruit and vegetable processing in this area.

Glass Production

The glass manufacturing industry includes four segments: flat glass, fiberglass, specialty glass, and glass containers. In the U.S., these segments employ more than 150,000 people and produce twenty-one million tons of products per year, with an approximate value of $22 billion.[9] Specialty glass, of significant importance to southern New Jersey, includes household glass, television tubes and other electronic glass, lighting glass, and scientific or lab glass. Due in part to the high number of pharmaceutical companies located in the state, nearly 50% of the nation's scientific glassware employers are in New Jersey, part of a national $300 million scientific glassware market.[10] In New Jersey, the glass industry employs over 8,000 people, 6,000 of which work in Cumberland County, particularly in Millville (where Alcan, Inc. has several plants), Buena, and Vineland. Alcan is a global conglomerate based in Canada that produces and distributes glass products for the science, cosmetics, and pharmaceutical markets. GlassGroup Inc. is also located in South Jersey, and is the largest specialty glass container company in the U.S.1[1] Scientific glass companies also are thriving in Cumberland County, producing technical products such as lab equipment. Industry figures indicate that 17% of all scientific glass companies in North America are located in greater Cumberland County. One in ten (11%) can be found along a strip of land between Newfield and Millville, an area known locally as "Glass Alley." Research suggests that the scientific glass industry has expanded in southern New Jersey in recent years due, in part, to the enduring skills of a labor pool that historically has been immersed in the glass industry; some of the skills of the labor pool are transferable from container to scientific glass.[12]

A major challenge to the glass industry is competition by plastic and aluminum products and the globalization of the industry. Interestingly, one of the competitive advantages of the New Jersey glass industry is recycling. Recycling glass enables manufactures to save on raw materials and New Jersey has one of the nation's, and the world's, highest recycling rates at 60%.[13] Meanwhile, glass container demand is stable, but could experience a decline in the future (as evidenced by the 1998 closing of the Ball-Foster plant in Millville), while the demand for scientific glass products is increasing.

Printing and Publishing

The printing and publishing sector consists of several segments. The largest is commercial printing, which prints newspaper inserts, catalogs, pamphlets, and advertisements and accounts for over 36% of total sector employment. The second largest segment is newspapers, which make up nearly 30% of the total sector employment.[14] Nationally, printing and publishing accounts for over 1.4 million jobs,[15] most of which are in small firms.[16] In New Jersey, there are 55,290 jobs in the printing and publishing sector, which is roughly 1.5% of all employment statewide.[17] The average hourly wage for a printing and publishing sector employee is $19.75, higher than the average hourly wage for all employees in the state ($18.80) and significantly higher than the national average hourly wage for an employee in this sector ($17.34).[18] Northern and central New Jersey contains a number of large newspaper firms and production facilities, including the *New York Times*, the *Daily News*, the *Star-Ledger*, the *Bergen Record* and the *Asbury Park Press*. In addition, many smaller commercial printing outlets also are concentrated in the area.

Employment in the printing and publishing sector is expected to decline slightly (0.2% nationally and 0.4% in New Jersey) from its current strength by 2010.[19] Some occupations, however, are expected to increase, including computer specialists and advertising sales agents. In the printing and publishing sector, industry wide cost cutting is common, as printers and publishers reassess costs to offset declining revenues stemming from low ad sales, decreasing circulation, and increasing materials costs.[20]

Chemical Processing

(Not including Pharmaceutical Manufacturing)[21]

Chemicals are an essential part of the manufacture of many goods. While some chemical manufacturers create and directly sell retail items like soap and bleach, most produce chemicals for intermediary use in other products, from construction materials to electronics. This sector consists of eight segments: plastics materials and synthetics; cleaning preparations; organic chemicals; inorganic chemicals; miscellaneous chemicals; paints and allied products; agricultural chemicals; and drug manufacturing.[22]

Two primary groups make up the chemicals manufacturing sector-commodity and specialty manufacturers. Commodity chemical producers generate large quantities of basic and relatively inexpensive compounds that typically are used in the production of other products. These substances are produced in large plants, often built specifically to make one chemical. However, specialty chemical manufacturers produce smaller quantities of more expensive chemicals that are used less frequently. Many traditional commodity chemical manufacturers are divided into two separate entities, one focused on commodities and the other on specialty chemicals.[23]

In 2000, 4% (723,000 workers) of the nation's manufacturing workforce was employed in chemicals manufacturing. Nationally, the plastics materials and synthetics area employs the largest number of people, while the smallest employer is in the agricultural chemicals area. The average size of the workforce at each facility varies considerably in the chemical sector, depending on the type of chemicals that are produced. For example, in the plastics segment, the average workplace employs 138 workers, while in soap and cosmetics that average is only thirty-five workers.

Individuals employed in the chemicals manufacturing industry work longer hours when compared to the average workweek of all private industries (43 and 35 hours, respectively). The sector also employs fewer part-time workers than others. However, their weekly wages ($768 in 2000) are substantially higher than the average for all private industries ($474). Unionization in this industry is slightly less prevalent than across all private industries (13.2% and 15%, respectively).[24]

With over 92,000 workers,[25] New Jersey is among the nation's top ten employers in the chemicals sector.[26] In addition, chemical production workers in the state are, on average, more productive than employees in other states, suggesting higher skill levels among workers.[27] In fact, one reason that this highly technical sector has been able to remain and succeed in the state is the availability of large numbers of highly educated and skilled workers to fill key jobs. In all, New Jersey generated $26 billion worth of chemical products in 2001, while national chemistry exports from New Jersey totaled $7.2 billion.[28] Each dollar generated by the chemical industry in New Jersey generates an additional one dollar of output.

However, due to a number of economic factors, including increases in plant automation, demand issues, spiking natural gas prices, and increased global competition, national employment within the chemicals sector (not including pharmaceutical manufacturing), is expected to decline by about 4% between 2000-2010.[29] As automation has increased throughout the sector, most of this decline is expected to occur among moderately skilled production workers. Despite declining overall employment in the chemicals sector, growth is expected to occur in some highly skilled occupations, including process technology technicians and programmers, environmental compliance and public relations staff, and specialized research and development professionals.

Figure 2.1: At-a-Glance: The Manufacturing Industry and Selected Sectors

Economic Impact

Industry as share of GDP (2001)[30]	14.1%
Industry as share of GSP (2001)[31]	11.5%

Employment and Compensation: National

Number employed (2003), in thousands[32]	Food and Kindred Products: 1523.6 Printing and Publishing: 691.7 Chemicals, except Drugs: 914.1 Glass Products: N/A
Average Weekly Earnings (2000)[33]	Food and Kindred Products: $514 Printing and Publishing: $545 Chemicals, except Drugs: $768 Glass Products: N/A
Projected Growth in Employment from 2000-2010	Food and Kindred Products: N/A Printing and Publishing: -1% Chemicals, except Drugs: -4% Glass Products: N/A

Employment and Compensation: New Jersey [34]

	Food & Kindred Products	Printing & Publishing	Chemicals & Allied Products	Glass Products
Number employed (2003)	34,720	55,290	92,480	8,000
Average Hourly Earnings (2003)	$15.75	$19.75	$23.60	$16.43[35]
Projected Growth in Employment from 2000-2010	-19.0%	-0.4%	-7.5%	N/A

b. Skill Requirements of Selected Occupation Groups

The advisory groups for this effort selected thirteen occupations for in-depth skill demand analysis. These thirteen occupations were selected by the advisory groups to include the occupations with the largest number of annual openings or that were expected to experience significant growth in openings in the next ten years. The advisory group members used estimates and projections produced by the New Jersey Department of Labor, as well as their own knowledge of the industry. In addition, the advisory groups considered occupations with a shortage of qualified workers. Finally, the advisory groups ensured that the selected occupations represented a diversity of education and training requirements.

In 2000, 933,700 individuals were employed throughout all industries in these thirteen selected occupations in the state (see Figure 2.2). The total number of individuals employed in these occupations is expected to decrease by 9.5% from 2000 to 2010. Replacement jobs, however, will produce 2,510 openings each year. The mean annual wages of these occupations ranged from $20,780 to $70,730 in 2003.

Figure 2.2: New Jersey Employment[36] and Earnings[37] in Selected Occupations* Throughout All Industries

Occupation	Mean Annual Wages 2003	Estimated Number Employed 2000	Projected Number Employed 2010	Percent Change 2000–2010	Annual Openings (due to both growth & replacement
CUSTOMER SERVICE/SUPPORT					
Sales Representative	$70,730	17,000	17,000	0.1%	460
LABOR AND SKILLED TRADE WORK					
Machinists	$36,580	8,500	7,700	-9.6%	180
Stationary Engineers and Boiler Operators	$42,435	2,200	2,000	-6.1%	60
Grinding/Polishing Workers	$31,120	1,100	1,100	0.7%	30
Cutters and Trimmers, Hand	$22,840	600	500	-17.6%	10
Helpers- Production Workers	$20,780	12,600	12,700	0.6%	330
Electrical and Electronics Repairers, Commercial and Industrial Equipment	$43,34	52,200	2,200	2.6%	50
MANAGEMENT/SUPERVISION					
First-line Supervisors/ Managers of Production and Operating Workers	$51,790	22,100	19,900	-10.3%	580
SCIENCE AND TECHNOLOGY					
nspectors, Testers, Sorters, Samplers, and Weighers	$31,930	13,600	11,700	14.2%	300
Chemists	$64,40	58,700	9,500	8.8%	350
Chemical Plant and System Operators	$42,860	3,200	2,700	-15.1%	100
Plant and System Operators, All Other	$36,315	800	800	2.6%	30
Industrial Health and Safety Engineers	$67,835	700	700-	1.2%	10
Food Scientists/Technologists	N/A	400	400	-18.3%	20

* Totals may not add due to rounding. Employment data are rounded to 100. Percent changes are based on unrounded data.

The thirteen selected occupations in the manufacturing industry largely fall into four "job groups" that share a common set of core competencies, basic educational requirements, and skill sets (see Figure 2.3). These include Customer Service and Support, including salespeople; Labor and Skilled Trade positions, including machinists, production laborers, stationary engineers, glass cutters and trimmers, glass grinding and polishing workers and instrument/electronics technicians; Management/Supervision, including first-line supervisors and production managers; and Science and Technology Application, including chemists, inspectors, food scientist/technologists and plant and system operators. A description of these selected occupations, their skill requirements and key workforce issues can be found in Appendix D. A searchable database of all selected occupations in the eight industries is available at www.njnextstop.org.

While within each job group the level of skill mastery required varies, the occupations within the job group share a common continuum of competencies and tasks. In a dynamic and fluid economy, the definitions and requirements of occupations change often and can vary from one employer to another. The grouping of occupations into job groups minimizes the effect of these differences.

Figure 2.3: Profile of Tourism and Hospitality Industry Job Groups

Job Groups	Description of Job Group	Occupations Included in Job Group	Education/Training Required or Preferred by Employers	Core Competencies[38]	Sample Occupational Skills
Labor and Skilled Trade Work	Building, repairing, installing, controlling, or operating equipment and materials.	Machinist Production laborer Stationary engineer Glass cutter and trimmer Glass grinding and polishing worker Instrument/ electronics technician	Union workers: H.S. diploma/G.E.D. and apprenticeship, which includes classroom and on-the-job training. Non-union workers: On-the-job training. Often, technical/ vocational certification required.	Precise application of tools and materials. Effective application of math concepts relevant to manufacturing. Understanding of and adherence to safety precautions. Knowledge and effective application of technology relevant to manufacturing. Ability to think critically and solve problems encountered on the work site. Ability to work as a team with multiple occupational sectors on a work site.	Mathematics Problem solving and critical thinking Equipment selection and maintenance Operation and control Installation and repairing Reading comprehension
Management/ Supervision	Supervising, coordinating, and planning work of site and staff.	First-line supervisor and production manager	H.S. diploma/G.E.D. Work experience. Bachelor's degree preferred for managers, especially among those applicants who do not have past experience with the hiring company. Associate's degree preferred for supervisors.	Use effective judgment and decision making to allocate resources and personnel to meet project budget and deadline. Communicate and coordinate the efforts of multiple project partners, vendors, and workers to share common organizational goals. Understand and adhere to safety precautions with consistency. Provides technical leadership across projects/disciplines.	Problem solving and critical thinking Entrepreneurship and business skills Coordination Communication and teamwork Monitoring Time management Management of personnel resources

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Job Groups	Description of Job Group	Occupations Included in Job Group	Education/Training Required or Preferred by Employers	Core Competencies[38]	Sample Occupational Skills
Sales/Relationship Management	Developing/ managing customer relationships, marketing and selling, and analyzing finances and needs.	Sales representative	B.A., B.S. Specialized certificates and/or licenses specific to job may be necessary.	Provide superior customer service and use effective organization skills to provide the appropriate follow through. Develop new customers through networking. Identify customer needs quickly and accurately and take actions to address those needs. Target the appropriate products/services to market to a potential customer. Apply advanced math, statistics, financial, and regulatory knowledge routinely and accurately. Use technology effectively to complete tasks.	Service orientation Communication and teamwork Systems evaluation Problem solving and critical thinking Reading comprehension
Science and Technology Application	The application and evaluation of technological and scientific processes.	Chemist Inspector Food scientist/ technologist Plant and system operator Industrial health and safety engineer	Varies. Many positions in this cluster require a postsecondary degree and/or substantial on-the-job training	Apply knowledge of technology and science relevant to industry practices. Use tremendous attention to detail while working to identify and assess system flaws. Demonstrate an understanding of and a consistent adherence to safety precautions.	Operation and monitoring Mathematics and technology Equipment selection Analysis Reading comprehension Writing

Labor and Skilled Trades

Description and Skill Requirements

The Labor and Skilled Trades job group includes both highly skilled and entry level workers who perform the "hands on" building, repairing, installing, and controlling of equipment and materials at a manufacturing facility. Occupations such as machinists, production laborers, stationary engineers, glass cutters and trimmers, glass grinding and polishing workers, and instrument/electronics technicians are in this job group. Some of these occupations are very sector-specific (i.e., glass cutters and trimmers) while others are endemic to each sector (i.e., machinists). Mastery and precise application of a range of tools and materials is necessary to succeed in this job group, particularly as new tools and materials are introduced to the industry. In addition, the ability to understand and apply technology to manufacturing work is critical, as manufacturing facilities become more technologically complex.

Workers within this job group can be divided into two groups: union or nonunion (or "open shop"). A unionized worker starts as an apprentice, and must complete a course of training and study that includes both classroom instruction and on-the-job training. Unions typically run their own apprenticeship programs. However, in New Jersey, the Bureau of Apprenticeship Training (BAT) also coordinates voluntary employer-based apprenticeships in some Labor and Skilled Trade occupations in the manufacturing industry. Upon completion of this process, apprentices become full members of the union, where they receive certain protections in the areas of pay, pension and job security. In contrast, most nonunionized workers are not required to complete an apprenticeship, and rely more on on-the-job training to gain the experience that employers require or prefer.

Emerging Skills

The emerging skills in the Labor and Skilled Trades job group include computer and other technology skills, as manufacturing facilities are becoming more technologically complex.

Workforce Trends and Issues

Several trends are influencing the demand for workers with these skill sets. As technology continues to permeate the manufacturing industry, workers must continually adapt and upgrade their skills. However, many of the workers entering these occupations, employers tell us, do not have the skills necessary to meet their skilled labor demands. The aging of the manufacturing workforce is a significant problem, as many workers in the Labor and Skilled Trades job group will be retiring in the coming years (union workers are eligible for retirement at age 55), resulting not only in worker shortages, but a drain on the institutional knowledge of the industry. In addition, the fast pace of technological advancement in the industry has made it difficult for many workers to keep pace with the growing sophistication of new equipment and processes used in the industry.

Another trend contributing to the lack of available skilled Labor and Skilled Trades workers is outsourcing. To save money, many manufacturing employers, particularly those in the chemical processing and printing and publishing sectors, hire temporary workers to fill unskilled positions. Many of these workers lack basic academic and language skills and are not prepared or encouraged to obtain better skills and move on to more highly skilled positions. In the past, many of these unskilled workers were permanent employees looking to move up within the company through on-the-job training, creating a pipeline of workers. Today's outsourcing methods create a breakdown in this pipeline and contribute to the growing knowledge gap that exists between skilled and unskilled workers.

Management/Supervision

Description and Skill Requirements

The Management/Supervision job group includes first-line supervisors and production managers, occupations endemic to all manufacturing sectors. First-line supervisors and production managers must use effective judgment and decision making to allocate resources and personnel to meet project budget and deadline, as well as communicate and coordinate the efforts of multiple project partners, vendors, and workers in a facility. At the same time, Management/Supervision workers must understand and adhere to safety precautions with consistency, and ensure that those that they manage do the same. These workers need excellent communication skills as well as extensive institutional knowledge of the production facility and its processes.

Emerging Skills

Emerging skills in this job group include computer and other technology skills, as manufacturing facilities are becoming more technologically complex. In addition, managers today employ a more diverse workforce than in the past, and cultural sensitivity is a skill that is becoming increasingly important. Managers must also stay abreast of evolving safety and security regulations.

Workforce Trends and Issues

Employers tell us that workers in these positions often are drawn from the ranks of the Labor and Skilled Trades job group, and include workers who have been in the industry for many years, have worked their way up to manager or supervisor and have extensive experience in the industry. For these jobs, work experience is currently more important to employers than formal education such as a bachelor's degree. In general, advancement into the highest management ranks depends on experience and proven ability to handle responsibility in several functional areas. However, the number of workers who have the skills and experience to enter these jobs is declining. Factors such as increased outsourcing of entry level jobs, which has limited the training and advancement opportunities for many workers, as well as the approaching retirement of many workers in the managerial occupations is resulting in a shortage of supervisors and managers. In addition, many managerial and supervisory jobs have quickly evolved into highly skilled positions that require a large and complex knowledge and competency base. As a result, employers do not always have the supply of experienced and highly skilled workers from which to tap managers and supervisors and are increasingly turning to younger workers with more formal education

Sales/Relationship Management

Sales people in the manufacturing industry not only sell products and services, they also develop and maintain long term relationships with customers and analyze customer needs on an ongoing basis.

Employers usually demand that workers in these positions have a college degree. Employers also prefer that new employees in this area have several years of experience in sales, customer service, or another area that demonstrates an individual's capacity to use persuasion effectively and to work well with people.

The competencies that a Sales/Relationship Management worker in the manufacturing industry must demonstrate to be successful include the provision of superior customer service and the ability to successfully develop new customers through networking. Depending on the sector, some sales representatives must have extensive scientific knowledge to explain the complexities of company products to customers and effectively analyze their product needs. For these jobs, workers often need a postgraduate degree in a field related to their job.

Emerging Skills

As technology increases productivity throughout the chemicals sector, new and more sophisticated products and production systems are being created faster than ever before. Therefore, sales representatives in this sector must be very adaptable and able to incorporate large amounts of complex new information into their communications with customers. For example, in the chemicals sector, sales representatives must develop a very sophisticated scientific knowledge base to understand and communicate to customers about company products and processes.

Workforce Trends and Issues

As global and domestic competition in the manufacturing industry increases, sales staff is becoming increasingly important in many companies. The high level of knowledge required to effectively sell some products, such as chemicals, is making it harder for some employers to find qualified sales staff.

Science and Technology

Description and Skill Requirements

The Science and Technology job group involves the application and evaluation of technological and scientific processes and includes chemists, inspectors, food scientist/technologists, plant and system operators, and industrial health and safety engineers. Some of these occupations are very sector-specific (such as food scientist/technologists), while others are endemic to each sector (such as plant operators).

The education requirements of this job group vary, with many positions requiring a postsecondary degree. Advanced positions such as a chemist, industrial health and safety engineers, or food scientist/technologist may require a Ph.D. However, the skill requirements for many jobs in this job group are similar, and include attention to detail, assessment and analytical skills, an understanding of safety procedures, and the ability to apply the appropriate science and technology to the job. In addition, some workers, such as industrial health and safety engineers, must be very familiar with the complex laws that regulate the industry.

Emerging Skills

The emerging skills in this job group include advanced computer and technology skills, as well as advanced knowledge of and the ability to apply and follow increasingly complex safety and security regulations.

Workforce Trends and Issues

Employers note that while many younger workers are comfortable with computer technology and its application, older workers with less technological facility face a bigger challenge in mastering these skills. However, as in the Labor and Skilled Trades job group, employers report that older workers have better abilities to solve problems and think critically without the assistance of computers and software.

In addition, occupations such as food scientist/technologist and industrial health and safety engineers are growing in response to both advances in food science and increased security concerns regarding the nation's food and chemical supplies. Plant and system operators also must address sophisticated safety and security regulations and procedures and be adept at applying them to their facilities.

III. Key Workforce Challenges

The manufacturing industry as a whole is facing myriad challenges. It is no longer the driving force of the American economy, which has gradually made the transition from an industrial economy to a service and knowledge-based economy. Factors such as globalization, advances in technology and an aging workforce have hastened the decline of nearly all manufacturing sectors in the United States. However, while these continuing job losses remain a discouraging reality, some areas of the industry are here to stay and many employers continue to need a variety of skilled workers. In addition, a large number of these available jobs are far more complex and sophisticated than many jobs in the industry were twenty to thirty years ago. Still, inaccurate and outdated knowledge about the jobs available in the industry, combined with the bias of a K-12 educational system that is increasingly geared toward college preparation, has resulted in three major workforce challenges. While some of these challenges affect nearly all sectors in the industry, some difficulties are more concentrated in some sectors than in others.

Challenge 1: Attracting and Recruiting Workers. Attracting and retaining workers with the skills needed to succeed in the industry is a constant challenge, due to increasing skill demands in some sectors and decreasing interest in the industry on the part of students and job seekers. In addition, industry modernization is leading to a trend toward higher skill requirements in many occupations in the manufacturing industry.

Despite the lack of new job growth in many manufacturing sectors in the state, an aging workforce, coupled with high employee turnover and difficulty recruiting new workers have combined to create an insufficient current and future supply of skilled production workers.[39] The majority (80%) of manufacturers surveyed by the National Association of Manufacturers say they are experiencing a moderate to serious shortage of qualified workers, with a concentration of serious shortages in the area of production machinists, craftspeople, and technicians.[40]

In New Jersey, new worker recruiting problems are compounded by the fact that other, more socially desirable industries have prospered in the state over the last few decades. Areas in and around New Jersey have become more focused on high technology, research, and communications jobs. As a result, policy makers, schools, parents, and, of course, the emerging workforce, have increasingly ignored manufacturing as an attractive career path. Many New Jersey manufacturers perceive that "parents are pushing schools to push kids toward college."[41] In fact, the one educator in Passaic county stated, "the type of youngster now steered into voc-tech is the low achieving troublemaker who can't fit into a traditional classroom and who has not developed self-discipline."[42] As a result, many voc-tech programs are underfunded and do not provide the hands on training necessary to prepare workers to perform in highly skilled occupations in the manufacturing industry.

The lack of effective marketing regarding what the manufacturing industry has to offer (good wages, benefits, pension) in sectors that remain competitive, combined with the current bias of the high school guidance system in favor of college, is aggravating supply issues. In particular, the statewide decline in vocational education programs at the high school level and the reluctance of high schools to encourage students to pursue careers in the industry has lead to a severe "pipeline" issue for the manufacturing industry.

The declining provision of training programs, as well as a poor understanding of opportunities for career advancement, has limited the appeal of careers in manufacturing. Many young people perceive the industry negatively, and are unaware of the opportunities for advancement within the industry. Many employers feel that the industry's outdated image as "dingy, dark, dangerous, and dead end" makes it difficult for manufacturers to recruit new, qualified workers.[43] A survey of area high school students found that almost 90% of the students said they would not want to work in a manufacturing setting. Many people are unaware that many jobs in the industry are becoming more technically and less mechanically oriented, providing opportunities for more knowledge-based work.

Challenge 2: Preparing Skilled, Qualified Entry-Level Workers. Employers report that workers entering the field do not have the skills needed to do their jobs effectively.

With production processes becoming increasingly automated and run largely by computers, chemical and other sectors of manufacturing employers are in need of highly skilled workers who can understand complex production processes and program computers to handle these tasks effectively. In addition, stricter environmental regulation and increased public awareness in this area ensures that individuals with skills related to environmental compliance and improving product visibility and consumer confidence will continue to be in demand throughout the sector. The same is true for individuals who possess advanced knowledge and skills with regard to safety and security regulations. Finally, increased demand for specialty chemicals has spurred the need for highly trained research and development chemists, engineers, technicians, and production personnel. An emerging trend in the chemicals sector-modeling chemical reactors and processes-will also increase demand for skilled professionals in this area.

In the printing and publishing sector, changes in technology are placing new technology demands on workers. For example, jobs such as electrical and electronics installers and repairers must now be able to troubleshoot and fix increasingly complex equipment. Increased use of the Internet means that sales employees must become increasingly skilled in using this medium to market their company's products and communicate with customers.[44]

Turnover is a persistent problem among many entry level positions in the manufacturing industry. For example, the food processing sector has a high turnover rate; one estimate is that there is at least a 20% worker turnover rate in New Jersey's food processing sector.[45] Employers indicate that it is difficult to find and retain entry-level workers who possess the necessary language and literacy skills. According to one New Jersey food processing manager, just two out of every five new hires actually report to work on the first day.[46] Similar problems occur in chemicals and printing and publishing, though at least part of the problem is the fact that many companies hire temporary workers to fill entry level jobs.

Challenge 3: Upgrading the Skills of Current Workers. Technological advances in the industry make it necessary to train incumbent workers and provide them with the skills they need to apply the new technology. Finding the time and the resources to provide this training is difficult for many employers, particularly small employers.

Manufacturers in New Jersey consist of both small and large firms. Small manufacturers have unique challenges in achieving competitive advantages in the marketplace. Most small businesses need to focus on production to survive; they do not have the opportunity or time to develop a skilled manufacturing workforce because of business pressures. While manufacturers prefer to upgrade the skills of their incumbent workers, they struggle to identify what specific skills are required.[47] This poses a challenge for employers, as many jobs increase in complexity and older methods of on-the-job-training are no longer sufficient. The fact that employers report that many low-skilled workers are now outsourced and are not in a position to gradually obtain skills through job experience also requires that employers better identify skill needs to recruit skilled workers from outside the company.

Employers note that specific knowledge gaps among older and younger workers are becoming increasingly problematic. In general, employers report that older workers have a firm grasp of the mechanical principles that govern plant operations, but are less able to adapt to the growing use of technology in the industry. In contrast, younger workers often are more comfortable using computers to complete tasks, but may be unable to solve critical problems when technological systems breakdown due to an insufficient knowledge base in basic mechanical, chemical, and other principles important in their jobs.

Given the problematic trends of an aging workforce and persistent difficulties in attracting and promoting new workers to careers in manufacturing, skill shortages will worsen if not properly addressed. In addition, a persistent shortage of qualified workers will impact product quality and process efficiency, both of which are key to helping U.S. and New Jersey manufacturers keep a competitive edge in the global economy. As training for many of the skilled production occupations in manufacturing requires a strong technical education background and several years of apprenticeship, the industry and others cannot afford to delay in their actions to address the skills shortage.

IV. Meeting the Challenges

As demand for workers in the manufacturing industry increases and the skill requirements of many jobs increase, the industry must attract more workers to the field and the quantity of training programs must be increased. At the same time, the transition from production to assembly that many manufacturers are engaged in necessitates attracting enough lower-skilled workers to fill entry level assembly positions.

Strategies to Attract and Recruit Workers

The need for skilled manufacturing workers can be addressed by increased efforts to recruit more immigrants and other groups that are underrepresented in the industry to the field. In addition, this demand can be met by more effectively by informing high school students about opportunities in the field through career awareness and job training programs.

High school guidance counselors and teachers have the responsibility to provide students with proper career information in a nonbiased way. However, employers cite issues with the typical high school guidance system, as the majority of students are encouraged to attend college and are not informed of other viable options. At the same time, many young people perceive the industry negatively and have a poor understanding of manufacturing occupations and opportunities.

The New Jersey Department of Labor has approved a variety of manufacturing programs at training facilities throughout the state. In the chemicals sector, Elizabeth High School, one of the state's largest, has developed a specialized program in chemical process technology to prepare secondary students to enter advanced technical programs at the college level. However, the state currently lacks an accredited post-secondary or technical certificate program in this area. The high school, industry representatives, and others are approaching community colleges throughout the state to encourage them to implement a curriculum for such a program. At least two community colleges, including Middlesex County College and Gloucester County College, are considering adding such a program using industry-based skill standards developed in other states.

Project SEED (Summer Educational Experience for Economically Disadvantaged High School Students) is a social action program that provides opportunities for students who historically lack exposure to scientific careers. High school students are placed in academic, government, or industrial research laboratories for eight to ten weeks during the summer. The students are paid a fellowship from funds raised by the American Chemical Society. Students may begin the program at the end of their junior year in high school and continue for the summer after they graduate as a bridge to college. Students are given real research projects, which they complete under the guidance of their research mentors at their institution. In New Jersey, 140 students participated in the program in the summer of 2002 alone.[48]

In Paulsboro, New Jersey, the Paulsboro High School conducts an annual "Game of Life." During this daylong program, local industries and employers come to the school. Students are given a random set of cards with various directions. For example, one card might instruct the student to go to a manufacturing employer table and ask "What opportunities are available at your company?" The student would then be required to go through a series of follow-up steps. Throughout the day, students follow the directions on their cards that simulate various life experiences. This program helps the students to learn, in a fun atmosphere, about the different opportunities available after high school. Employers assert, however, that while programs such as these are valuable, career information must be targeted towards students before they enter high school.

The New Jersey Bureau of Apprenticeship Training currently coordinates apprenticeship opportunities in the manufacturing industry for the state's high school youth as part of New Jersey's School-to-Work efforts.

Finally, technical academies have been established in northern New Jersey counties, such as Bergen and Passaic, to provide high school students with training in manufacturing technology. These programs also provide internship opportunities.

Strategies to Prepare Skilled, Qualified Entry-Level Workers

Improving the Basic Academic Skills and Work Readiness of Students Interested in the Industry. One of the most difficult tasks facing employers in the county is determining the level of workplace readiness in job applicants. Cumberland County and the county colleges of several southern counties offer a range of programs that target the manufacturing industry, as well as initiatives that are designed to increase the workforce preparedness of high school graduates. For example, the Cumberland County *SchoolCounts!* program provides a credentialing system that ensures workforce readiness while simultaneously encouraging academic success. The purpose of the program is to emphasize to high school students the vital link between academic performance and future employment and educational opportunities. It is sponsored by the

Cumberland County Business and Education Alliance and the Cumberland County College Foundation. The program is a statewide initiative sponsored by the Business Coalition for Educational Excellence of the New Jersey Chamber of Commerce. However, Cumberland County College is the first institution in the state to use *SchoolCounts!* as a means of credentialing the workforce as well as advancing educational opportunity through college scholarships.

Over 450 county employers participate in the program. When interviewing for positions, employers are encouraged to request this certificate documenting student performance and the achievement of goals related to work habits. The program criteria include:

1. Obtaining a grade of C or better in every course (Quality)
2. Achieving a 95% attendance and punctuality record (Attendance)
3. Completion of high school in eight consecutive semesters (Persistence)
4. Taking more than the minimum number of credits required for graduation (Rigor)

Certificates are awarded by each high school at the end of the academic year to all students who have met the program criteria. These certificates are a convenient way of alerting an employer that the job candidate has developed strong workforce readiness skills in the areas of quality, attendance, persistence, and rigor. Similarly, students learn that their academic performance and work ethic are important determinants in their selection for available positions and in their success once they are on the job.

In 2001, 736 high school students earned first year certificates. In addition to these components of the statewide model, Cumberland County College provides a two-year scholarship to any student that earns four *SchoolCounts!* certificates.

Union County College (UCC) has an interesting program called "College for Kids." The UCC College for Kids offers non-credit programs for youth, ages 4-16. During the fall and spring semesters, the Division of Economic Development and Continuing Education schedules Saturday courses and workshops on a variety of topics, including a kindergarten and first grade series, "Parent and Child Together" series, a stock market game, test taking strategies, LAN and wireless networking, web page building, a teen series, and test preparation courses. The goal of the program is to "offer something for everyone" in a fun environment. This program targets kids at a young age, prior to entering high school, and offers opportunities to improve basic academic skills, as well as explore activities such as web page development that could lead to interest in a variety of careers.

Postsecondary Education Programs

Salem Community College offers a scientific glass technology degree that is the only program of its kind in the nation. The program is a combination of classroom and hands-on laboratory experience. Students learn the technical skills of scientific glass blowing (cutting, heating, bending, shaping, and sealing) and the understanding of blueprint reading and advanced fabrication.

Salem County College also offers an associate's degree in applied science in process technology. Process technicians are the manufacturing operators who convert raw materials into the products people need and want, from food to pharmaceuticals. This program was developed in response to the needs of industry employers in the region and includes their input. Scholarships are available for this two-year program, which includes practical courses in math, chemistry, and communications; technical courses in process technology using fully equipped labs and simulation software; and computer, technical, and communications skills vital for industry success.

Strategies to Upgrade the Skills of Current Workers

Manufacturing is changing at a rapid rate, as many processes become more technologically complex and new procedures are implemented to ensure safety and security. Incumbent workers need the support and resources necessary to maintain and upgrade their skill base if they are to do their jobs effectively.

Cumberland County College has developed a Consortium for Manufacturing Excellence. Its primary goal is to bridge the gap between business needs and the skills of the existing workforce. The role of the consortium is to dramatically improve the environment for manufacturing in Cumberland County through skills building. It will target emerging workers through high school visits, training for administrators, guidance counselors and teachers in the area of manufacturing, dual credit programs, and possible Career Academies through Tech Prep; incumbent workers through the consortium's efforts to develop and implement comprehensive training and development programs to continually upgrade the skills of incumbent workers; transitional or displaced workers through a Workplace Readiness module developed for consortium members' new employees who are assessed as being in need of such a program; women and minorities will be placed as high priority for recruitment; Empowerment Zone census tract residents will also be placed as a high priority for recruitment and given the opportunity to learn English as a Second Language (ESL) prior to more advanced training. Possible course offerings may include blueprint reading, measurements and math, manufacturing concepts, teamwork and communications, statistical process control, problem solving, business of manufacturing, computers and manufacturing, and manufacturing certificate in ESL.

Programs sponsored by the state have provided valuable support to the manufacturing industry. The New Jersey Registered Apprenticeship Incentive Program, a joint project of the state Departments of Labor and Education, provides financial incentives to small- and midsize firms who make a commitment to train an apprentice in a manufacturing trade.[49] Customized training grants are matching grants awarded to New Jersey businesses to provide training to the company's workforce in skills specifically needed to increase productivity and to increase marketability. The grants, awarded through the Department of Labor, are funded through the Workforce Development Partnership Program and largely target the manufacturing industry, providing millions in funds to employers for worker training.[50]

Additionally, industry associations, for-profit workforce development organizations, and state-based consortiums have developed a variety of skills standards for jobs in the manufacturing industry. These skill standards provide information educators need to develop curriculums that meet employer skill needs. Employers also use these skill standards to assess competency levels among their employers.

In South Jersey, the Food Industry Research and Extension Center (FIRE) at Bridgeton seeks to conduct research, outreach, and education to better meet the needs of the region's food processing sector. Workforce development and training is one part of FIRE's proposed overall mission, which also includes a business management program, marketing program, and product development program.[51]

The American Chemical Society also offers online courses and other educational resources and has developed skill standards for the industry. The New Jersey Department of Labor has approved ten to fifteen programs throughout the state to train technicians and chemists.

The printing and publishing sector offers similar resources. For example, the Document Management Industries Association and the Society for Service Professionals in Printing, an association dedicated to the educational advancement and recognition of customer service professionals in the printing industry, have developed Print University, an online curriculum of courses and certificate programs for printing professionals.[52]

The Printing Industry Center at Rochester Institute of Technology (RIT) is a joint program of the School of Print Media and RIT's College of Business. Dedicated to the study of major business environment influences in the printing industry precipitated by new technologies and societal changes, the Printing Industry Center at RIT addresses the concerns of the printing industry through educational outreach and research initiatives. The center creates a forum for printing companies and associations worldwide to access a neutral platform for the dissemination of knowledge that can be trusted by the industry, to share ideas and to build the partnerships needed to sustain growth and profitability in a rapidly changing market.

V. Recommendations

The manufacturing industry is faced with a number of challenges in meeting its current and future labor and skill needs. In recognition of this issue, the industry and many of the state's two-year institutions of higher education have already developed a number of programs and initiatives to increase both the supply and the skill level of manufacturing labor. However, the industry should consider additional steps that would support and build upon current efforts, further strengthening current manufacturing labor force and increasing the pipeline of future workers. These include:

1. Recommendations to Attract and Recruit Workers

Increase Awareness of Careers in the Industry Among High School Students

Create Better Career Education Opportunities for Students. Employers note that many young people do not have an accurate understanding of the nature of work in the manufacturing industry, nor do they understand what career opportunities exist. Education, workforce development, and industry groups should work together to better educate students of all ages regarding the full range of career opportunities available to them, including careers in the manufacturing industry. Informational websites, career awareness fairs, internship opportunities, and career awareness activities integrated into school curriculums could be initiated on state and local levels to further these efforts.

Develop Marketing Campaigns

Coordinate Existing Efforts to Develop an Industry Marketing Strategy. The manufacturing industry-perhaps using the Constructions Career Kit as a model and starting point-must develop a comprehensive, industry wide marketing strategy that provides high school students, guidance and career counselors, and the workforce development system with information on careers in manufacturing. This strategy must build on the efforts of trade unions, the New Jersey Department of Labor, and local business groups such as the Consortium for Manufacturing Excellence to recruit individuals to jobs in the manufacturing industry.

This strategy should heavily promote the benefits of a career in manufacturing (high pay, benefits, pensions, availability of jobs) and raise the profile of the industry from the commonly perceived "blue collar" image to one that emphasizes some of the high skilled, technology dominated aspects of the industry. As one employer notes, "providing salary information for many manufacturing jobs will wake up a lot of people to the good opportunities available in the industry." The industry should coordinate this marketing effort with the state's community colleges, particularly those with programs and curricula already in place. This marketing strategy should target grammar and high school students, as well as college graduates and other

job seekers, with particular attention paid to immigrants. For example, the Building Contractors Association of New Jersey (BCANJ) has developed Build Up! Tool Kits that are used as a means of acquainting fifth grade students with the world of construction. BCANJ members sponsor these kits at a cost of $199 each, and the organization has placed hundreds of units with elementary schools throughout the state. The manufacturing industry can model a similar program on this effort.

Recruit Workers from Untapped Labor Pools

Attract Immigrants to the Industry in South Jersey. Employers in South Jersey tell us that they have been slow to embrace the immigrant labor pool. They stress, however, that they are a viable source of labor, particularly for entry level, hard-to-fill positions, positions that will increase as many employers shift from production to assembly. In addition, women, job seekers transitioning off welfare, people collecting Unemployment Insurance, and users of the One-Stop Career Center system should be informed about opportunities in the manufacturing industry.

Employers suggest that the local One-Stop Career Centers could play a role in accessing immigrant workers, perhaps through ESL classes, citizenship classes, and other strategies to integrate this labor pool into the workforce.

2. Recommendations to Prepare Skilled, Qualified Entry-Level Workers

Strengthen Secondary Education

Incorporate Workplace Readiness Needed in the Workplace into School Curriculums. Employers in this and other industries complain that many entry level workers lack workplace readiness skills that are necessary to succeed in nearly all jobs in the twenty-first century world of work. High schools should work to incorporate these key skills into the curriculum. Since skills such as interpersonal, communication, critical thinking, and problem solving skills can be applied in any discipline, these skills can be incorporated into existing curricula.

Workplace readiness skills should also be integrated into the high school experience as well. While still in its infancy, the *SchoolCounts!* Program, in place in several counties in New Jersey and developed by the Business Coalition for Education Excellence at the New Jersey Chamber of Commerce, may be a promising approach. This program rewards students by issuing an employer-recognized certificate to students for promising behavior such as consistently high attendance rates, above average academic performance, finishing high school on time, and taking initiative by enrolling in extra courses. Local employers enrolled in the program agree to accept the *SchoolCounts!* Certificate as evidence of workforce preparedness.

Strengthen and Reward Occupational Education. The public education system and the State of New Jersey must strengthen the vocational technical (voc-tech) system and acknowledge its value in preparing students for careers. One way to do this is for the state to reward achievement in the voc-tech system. For example, the State Report Cards on schools provide statistics on the number of college-bound students, student SAT scores and other academic information. It should also include statistics on the number of students accepted into unions, apprenticeships and training programs. Currently, these statistics just fall into the "Other" category. Student vocational education achievements should be praised and promoted equal to academic and college achievement.

In addition, the state should eliminate the financial disincentives to public high schools to have students enter voc-tech programs, as state funding attached to that student is transferred from the public school to the voc-tech. At the same time, the state must find ways to equally fund occupational education as it does college preparatory education.

Finally, labor unions and employers should work closely with schools to strengthen vocational school education programs through curricula, materials, and technical assistance.

3. Recommendation to Upgrade the Skills of Current Workers

Use Funds from the Customized Training Program to Support the Development of New Industry/Education Partnerships. The customized training program of the New Jersey Department of Labor provides matching grants to businesses and groups of businesses to provide training to their employees. The program largely targets businesses in the manufacturing industry. A portion of the funds from the program should be used to strategically support industry/education partnerships to upgrade the skills of current workers in growth sectors of manufacturing. Such funding could be used by community colleges in partnership with groups of employers with similar skill needs to develop curricula and programs that could be used even after the grant ends.

4. Overall Recommendations

Develop Industry/Education Partnerships to Address Workforce Challenges. Employers, educational institutions, and government must work together to address the workforce challenges in the industry. The Glass Industry Collaboration of New Jersey (GICNJ) provides a model for such partnerships. GICNJ should be expanded and the model exported to other sectors of the industry.

GICNJ, formed in May 2002, includes representatives from several area glass companies and Rowan University's Management Institute and College of Engineering. This group represents 80% of the glass industry's NJ employees and focuses on promoting awareness of the glass industry, strengthening the current workforce through training, developing a future workforce by promoting career opportunities, and increasing communications and collaboration within the glass industry.

Figure 5.1: Recommendations by Stakeholder

	State Government	Workforce Investment Boards	Secondary Education	Post Secondary Education	Employers/ Associations	Unions
Recommendations to Prepare Skilled, Qualified Entry-Level Workers						
Strengthen Secondary Education						
Incorporate Workplace Readiness and Foundational Skills Needed in the Workplace into School Curriculums	x		x			
Strengthen and Reward Occupational Education	x		x			
Recommendations to Attract and Recruit Workers						
Increasing the Awareness of Careers in the Industry Among High School Students						
Create Better Career Education Opportunities for Students	x	x	x			
Develop a Took Kit for High School Teachers			x		x	x
Develop Marketing Campaigns						
Coordinate Existing Efforts to Develop an Industry Marketing Strategy	x	x			x	x
Recruit Workers from Untapped Labor Pools						
Attract Immigrants to the Industry in South Jersey	x	x			x	x
Use Funds From the Customized Training Program to Support the Development of New Industry/ Education Partnerships	x			x	x	
Develop Industry/Education Partnerships to Address Workforce Challenges		x	x	x	x	x

VI. Conclusion

In 2003, the New Jersey manufacturing industry is in a unique position. Buffeted by global macroeconomic trends and technological advances, manufacturing employment overall is in decline, yet manufacturers continue to employ significant numbers of New Jerseyans. At the same time, some high tech "niche" sectors, such as scientific glass, have emerged as growth industries. Other sectors continue to have a strong presence in the state due to factors such as the availability of a relatively highly skilled workforce in New Jersey, the need for quick delivery to customers, access to the state's natural resources, and the state's proximity to major industrial markets.

However, several factors threaten to negatively impact those manufacturing firms who remain, or would consider moving to New Jersey. An aging workforce approaching retirement is draining skilled workers from many jobs, and fewer qualified workers are in line to take their place. Technology is increasing the skill demands of many workers, while the shift to assembly in some sectors, such as glass production, is increasing the demand for lower-skilled workers. The industry, therefore, is faced with a dual challenge: meeting the skill and workforce needs of these emerging higher tech, higher growth sectors and maintaining the competitiveness and viability of older manufacturers.

Employers in the manufacturing industry are engaging in a number of initiatives to raise the profile of the industry and increase the supply of skilled workers. The industry should continue and expand upon these efforts, targeting guidance and career counselors and students with marketing materials and working with county colleges to develop much needed curriculum and degree and certificate programs. An aggressive and expansive marketing strategy is essential, particularly one that targets young students and immigrants. State policymakers and the public education system must take steps to address fundamental inequities in the funding of occupational education, and to reduce the bias against noncollege bound students. While employers agree that a large part of the onus is on them to target, recruit, and train workers, they see an important role for educators and policymakers to play in creating a climate more favorable to the growth of the manufacturing labor force. Finally, the Cumberland/Salem WIB should maintain and support the Industry Advisory Group formed as part of this project. This group can act as the catalyst for new initiatives and provide a valuable communication venue for manufacturing employers to address current and future workers and skills needs crucial to their success in New Jersey.

[2] A full discussion of the methodology used for this study is included in Appendix A.

[3] A full list of advisory group members is included in Appendix B.

[4] A full list of focus group and interview participants is included in Appendix C.

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Appendix A: Methodology

Methodology for Industry Reports

The Workforce Investment Boards of Bergen, Cumberland/Salem, Hudson, Mercer, and Passaic Counties, in partnership with the New Jersey State Employment and Training Commission, selected the industries for study based on their prevalence in the state and regional economies, their current employment rate, and their potential for job creation.

The Heldrich Center, with input from each WIB, conducted a thorough literature search, or "knowledge inventory," for each industry. The Heldrich Center compiled background research using the Internet and published research reports on the current and emerging national and state trends, and focused on emerging trends and growth projections in the selected industries. The knowledge inventory formed the basis of the industry reports.

The Heldrich Center utilized New Jersey Department of Labor Labor Market Information (LMI) data to create a list of occupations for each industry. The primary criterion was gross openings and expected growth. The secondary criterion was occupations with a shortage of qualified workers and those that displayed a diversity of income and educational levels. The Heldrich Center created a ranking of occupations for review by the WIBs. The WIBs, based on input from each Industry Advisory Group, selected a subset of occupations for study that represented the above criteria and/or their own experience within the industry.

The WIBs convened an advisory group for each industry to guide the project. The advisory group consisted of employers and other key industry stakeholders. The advisory group aided in the selection of occupations for study and provided input regarding report recommendations. The groups met twice throughout the project.

The Workforce Investment Boards, with assistance from the Heldrich Center, Cumberland County College, Mercer County College, and William Paterson University, convened four or more focus groups for each industry. These focus groups were facilitated by the Heldrich Center, and included industry and educational representatives. In addition, the Heldrich Center and its research partners conducted ten or more phone interviews per industry with human resource or key operations managers regarding current and future skill issues and requirements.

Methodology for Emerging Skills Report

In December 2002, the Heldrich Center and the New Jersey Commission on Science and Technology (NJCST) convened a meeting of nine economic and technology forecasters and industry specialists to identify current and emerging trends influencing demand for skilled workers nationally and in New Jersey over the next three to five years. During this meeting, participants identified the fastest growing industrial sectors in New Jersey and the developments in science and technology that will lead to job growth and changes in work.

In January 2003, the Heldrich Center and the Commission on Science and Technology convened focus groups to further explore current and emerging trends in biotechnology/pharmaceutical and security (both physical and data) and to identify the skills that these trends may require. The NJCST identified key individuals from these emerging industries to participate in the sessions. Participants were asked to identify the fields within these industries that will be most important, the types of work that will emerge and the required skills, and the preparation that is necessary for these fields. Focus group participants also discussed the challenges and opportunities that employers face in these industries in identifying, recruiting, and hiring qualified employees.

For the remaining emerging industries discussed during the December forecaster meeting (food, e-commerce, e-learning), the Heldrich Center conducted telephone interviews to explore further current and emerging trends and to identify the skills that these trends may require. NJCST identified key individuals from these emerging industries to be contacted for interviews. Interviewees were asked to identify the fields within these industries that will be most important, the types of work that will emerge, and the required skills, and the preparation that is necessary for these fields. They were also asked to discuss the challenges and opportunities that employers face in these industries in identifying, recruiting, and hiring qualified employees.

The Heldrich Center compiled background research using the Internet and published research reports on the current and emerging trends identified by participants. This research focused on emerging trends and growth projections in the identified fields. Given the fact that these industries are emerging, the amount of information available varied. In such cases, the Heldrich Center focused on the information gathered from experts in the emerging trends meeting, focus groups, and telephone interviews.

Appendix B: Advisory Group Members

North Jersey

Christina Umstead	North Jersey Media Group
Cynthia Forster	The Bergen Record
Ramona Rowe	The Star Ledger
Glen Proctor	The Star Ledger
John Callendrillo	North Jersey Media Group
John King	North Jersey Media Group
Jane Maxcy	North Jersey Media Group
Phil Cronin	Isocorp
Chris Pondish	Passaic County Community College
Karen Strouse	Croda USA
Joe Brugard	Octagon Process
Tom Rankin	Exxon
Larry Kutzin	QT Bras

South Jersey

Terri Abriola	PEG, Inc
Rustin Cassway	Demountable Concepts
Chris Cummings	City of Bridgeton
James Economy	Durand International
Scott Elliott	Seabrook Brothers & Sons
Michelle Hoffman	Clement Pappas
Stephen Kehs	County of Cumberland
Laurie LaTorre	Alcan Packaging
James Lelli	City of Vineland
Harry Perry	PACE Local 2-943
Claire Riggs	Valero Refining Company
Jerry Velazquez	Cumberland Empowerment Zone Corp

Appendix C: Focus Group and Interview Participants

Terri Abriola	PEG, Inc
Terri Baglieri	Scientific Design
Kent Bania	Passaic County Technical Institute President
Mark Brizzi	Challenge Printing Company
MJ Crowley	Star Ledger
Jim Economy	Durand International
Alan Ficarotta	Casa Di Bertacchi
Scott Elliott	Seabrook Brothers & Sons
Julie Elmer	Food Innovation Research & Extension Ctr.
Fran Fischer	Jewish Vocational Services
Gabrielle Gillespie	L'Oreal USA
Michelle Hoffman	Clement Pappas
Diane Holtaway	Food Innovation Research & Extension Ctr.
Mike Hopp	Mannington Mills
Stephen Kehs	County of Cumberland
Deborah Knighton	MANE USA
Diane Knoop	Alcan Packaging
Barry Kramer	Management Institute at Rowan University
James Lelli	City of Vineland
Monika McSweeney	LCW
Nancy Miller	New Jersey AFL/CIO
Linda Moore	Estee Lauder
Kristina Morton	General Mills/Progresso
Ron Novak	IFF
Kim Poeppel	Cumberland Dairy
Carol Price	Valero Refining Company
Claire Riggs	Valero Refining Company
Daryl Smith	Salem Community College
Angel Soto	Cardolite Corporation
Jim Strahan	Kimble Glass
Lillian Torres	Ameribrom
Keith TurnerK-Tron	International, Inc
Jerry Velazquez	Cumberland Empowerment Zone, Corp
Katrina Watkins	Salem Community College
John Zeigler	NJ State AFL/CIO/Rutgers
Geoff Zoeller	Salem County Vocational Technical School

Appendix D: Profile of Selected Occupations

1. STATIONARY ENGINEERS

Stationary engineers are responsible for the operation and maintenance of a variety of mechanical equipment in a variety of industrial settings. They might operate engines, turbines, generators, boilers, or any number of other types of heavy equipment. As the name implies, workers in this occupation typically work at a fixed workstation, controlling a given machine's operations.

Stationary engineers must have a strong mechanical sense. They must be efficient problem solvers, and possess impeccable attention to detail. They should have good troubleshooting and repair skills, to conduct maintenance operations on their machinery. Though many firms pick graduates of trade schools to fill their stationary engineer positions, each specific job within this occupation has widely varying educational requirements, and some remain open to those with just a high school diploma or G.E.D. Many, however, require not only a trade school background, but also a number of different licenses and certificates.

Stationary engineers are confronted with an increasing incidence of computer usage, as larger firms migrate their heavy mechanics into computer-controlled environments. While smaller firms are resisting the trend (due in large part to the tremendous outlay of capital that computerization requires), even they are often forced to modernize, with the result that nearly every new stationary engineer is expected to have at least passing familiarity with computers and computer software.

2. FOOD SCIENCE TECHNICIANS

Food science technicians are responsible for the testing and quality control of various foods or beverages. They formulate and conduct tests and experiments to develop a complete picture of a physical and chemical makeup of different products. They often are called on to fabricate food or beverage products via the manipulation of chemical or biological agents. Food science technicians must work closely in concert with the Federal Drug Administration (FDA), and often must interact with consumers. They frequently are required to write reports summarizing their activities.

Food science technicians need exceptional knowledge of the principles of chemistry and biology. They must also have a solid grasp on applied math and mathematical concepts, to facilitate product testing. Food science technicians should be excellent communicators, with a strong writing and comprehension skills. They should be good critical thinkers, and have exceptional skill at recognizing and correcting problems. Additionally, employers note the need for employees with consistently high levels of integrity and solid ethics. Employees in this occupation usually have a bachelor's degree, most often in chemistry or biology, though degrees in other quantitative fields are sometimes acceptable.

In the aftermath of September 11th, regulations governing food science have tightened considerably. Food science technicians must stay abreast of new regulations, and are increasingly expected to interact frequently with the FDA and other governmental agencies. These tightening rules have made the job significantly more complex.

3. PRODUCTION LABORERS

Production laborers are responsible for a number of different tasks, depending on the specifics of their employment. The work can be physically demanding and difficult. Production laborers are sometimes required to load and unload items from machines or conveyor belts. They often must lift items, from raw materials to finished products, and are occasionally required to transport products from one area to another, either carrying them by hand or using some sort of mechanical assistance.

Production laborers must be in good physical shape. They must be adaptable, able to quickly shift from one job group to another. They must be able to read in English, to interpret work orders and requests from superiors. Employers note that this occupation has a very high turnover, and stress that dependability and a solid work ethic are highly valued. Employees in this occupation often are required to have a high school diploma or a G.E.D., but not always.

4. MACHINISTS

Machinists operate a wide variety of machine tools to fabricate or repair products for which precision is a priority. They are expected to read blueprints and measured drawings to conceptualize and conduct the necessary machining. They use finely-tuned precision tools, such as lathes and grinders, to achieve a variety of shaping effects. They often are required to use computer numeric control (CNC) machines, which require programming or input from users to function properly. Machinists often are required to conduct basic assembly operations on the parts they produce. They are frequently called on to troubleshoot or upgrade their various pieces of equipment and make minor repairs.

Machinists must possess exceptional mechanical knowledge, to understand and implement the various drawings that they are given. They must have a solid grasp of the fundamentals of mathematics, and a good grasp of design techniques. Critical thinking and troubleshooting skills are critical at all times during the machining process. Machinists should have an excellent command of logic and reasoning. A high school diploma or G.E.D. is required for employment, and a trade school background is ideal, but not required. Many employers require completion of an apprenticeship.

Demand for machinists is growing, as qualified employees become harder to find. A number of factors have caused this shortage, including the aging of the workforce (many machinists are approaching retirement age), a reduction in the number of apprenticeships available, and a poor general image of the occupation among high school students. Employers also note that the lack of high school "shop" classes has led to fewer students with the skills necessary to enter apprenticeship programs. The high demand for machinists frequently leads to bidding wars among various firms.

5. FIRST-LINE SUPERVISORS/MANAGERS OF PRO DUCTION AND OPERATING WORKERS

First-line supervisors oversee the work of production and operating workers. This group includes inspectors, machinists, assemblers, fabricators, and plant and system operators. The supervisors interact directly with workers and serve as a conduit through which company management can pass directives to the labor force. Supervisors interpret charts and data to better streamline the workforce, and set

work schedules and assignments based on their evaluations. They are sometimes consulted on general managerial changes, and are often responsible for making recommendations for the improvement of labor efficiency and quality.

First-line supervisors must have excellent personnel management skills, as well as effective negotiation skills, to juggle their various roles. They should have a solid grasp of the fundamentals of economics and of mathematics and its industrial applications. Supervisors should be excellent critical thinkers, with a focus on problem identification and problem solving. They must have strong decision making skills, and be effective leaders. Ability to instill and teach teamwork is a definite plus. In addition, first-line supervisors should be exceptional communicators, with equal importance placed on speaking and listening skills. For many employers, Spanish language skills are tremendously helpful. In the wake of corporate scandals such as Enron, a new importance has been given to ethics, which has made hiring significantly more complex. Many firms hire for these positions from within their company. Supervisors must have a high school diploma or G.E.D., and preference in the hiring process is given for those with a two-year degree. Many firms prefer graduates of four-year colleges, with degrees in engineering.

6. PRODUCTION INSPECTORS, TESTERS, GRADERS, SORTERS, SAMPLERS, WEIGHERS

This wide selection of occupations encompasses a number of tasks. Workers can be required, respectively, to inspect, test, grade, sort, sample, or weigh a selection of items, ranging from raw materials to finished products. These tasks may be conducted at any point in the production process. These occupations often are centered on quality control, and may overlap (for example, an inspector might grade materials, or a grader might sort materials).

Employees in these occupations must have excellent comprehension and pattern recognition skills, as well as good attention to detail. They must have good communication abilities, with a focus on reading and writing skills. They often are required to have experience reading blueprints, and have basic math and science skills. Inspectors, testers, and graders, in particular, must possess intricate knowledge of the regulations governing the manufacturing industry. Generally speaking, these positions require a high school diploma or G.E.D. In some cases, more training is necessary.

Like many occupations in this industry, there recently has been a dramatic increase in the computerization of many of these jobs. Accordingly, computer skills are now a must. Additionally, as customer and regulatory standards increase, inspectors, testers, graders, sorters, samplers, and weighers become dramatically more important. As a specific example, rising food safety standards resulting from the increase in security following September 11th have made these occupations more crucial than ever before.

7. CHEMICAL PLANT AND SYSTEM OPERATORS

Chemical plant and system operators are responsible for the control of a chemical process, usually carried out by a series of machines. They must monitor various instruments and panels to ensure that the process is going as it should, and must make adjustments according to their monitoring. Chemical plant and system operators are responsible for the manipulation of various valves and switches to maintain process integrity. When a problem is detected, plant and system operators are the first line of troubleshooting, and are expected to be able to catch most simple problems.

Chemical plant and system operators must have excellent knowledge of chemistry and chemical processes. In addition, they must be intimately familiar with the mechanical processes of the system on which they work. Critical thinking and troubleshooting skills are crucial. Chemical plant and system operators must be able to think in terms of systems, intuitively understanding the effect that one change can have on the rest of the system. Employees in this occupation typically are required to have at least a two-year degree in a related field.

More than many occupations in the manufacturing industry, chemical plant and system operators' tasks are being automated and computerized. While in some cases this has reduced the workload on the operators, this is not the standard. Rather, operators are finding their positions shifting in required responsibilities and knowledge. The most pressing new skill, therefore, is familiarity with computers and computer applications. Employees must be detail-oriented and familiar with concepts of operation monitoring. These new skills allow them to watch over the same processes via a new set of outputs.

8. CUTTERS AND TRIMMERS, HAND

Cutters and trimmers use a variety of tools to cut or trim manufactured products, such as carpet, stone, or rubber. Using hand tools or power tools, cutters and trimmers shape materials to various specifications. They are required to read and interpret blueprints or work orders to cut the correct shape on a given product. They must inspect their work to ensure a lack of defects and mistakes. Cutters and trimmers typically are required to be familiar with a number of different cutting mechanisms.

Cutters and trimmers must have scrupulous attention to detail, often making precise cuts at difficult angles. They must have good dexterity and excellent coordination. They must be able to take, read, and convert measurements in both English and metric units and exercise basic math skills. Employees in this occupation are required to have a high school diploma or G.E.D., and trade school experience is preferred.

Demand in this occupation is high, because it has become difficult to find qualified workers. Employers note that high school students are increasingly uninterested in this occupation, and that attracting new workers to the job is a tremendous challenge. In addition, employers note that a large number of their current employees in this occupation are at or approaching retirement age.

9. CRUSHING, GRINDING, AND POLISHING MACHINE SETTERS, OPERATORS, AND TENDERS

Employees in these occupations operate machinery that crushes, grinds, or polishes a variety of materials, such as glass, stone, or coal. They are responsible for observation of the materials during the process, and are required to adjust the machinery according to their observations. They perform basic troubleshooting (clearing material jams, for example). Machine setters, operators, and tenders are required to read work orders, to ascertain product information, and to set their machinery accordingly.

Machine setters, operators, and tenders should have a good knowledge of general production techniques. Mechanical acuity is important, to foresee and prevent mechanical problems within the machinery. They should have good troubleshooting and problem solving skills, as well as a basic comprehension of mathematics and measurement. Ability to read blueprints and work orders is crucial. Employees in this occupation typically are required to possess a high

school diploma or G.E.D. Trade school background is sometimes preferable, but many employers conduct training on site.

Like cutters and trimmers, demand for machine setters, operators, and tenders is high, because of a shortage of qualified, interested workers. Attracting new workers to the field has become increasingly difficult as the manufacturing industry's image has faltered in the eyes of potential employees. In addition, many current workers are approaching retirement age, which will raise demand even further.

10. INDUSTRIAL SAFETY AND HEALTH ENGINEERS

Industrial safety and health engineers are responsible for the creation and implementation of safety programs to prevent or address environmental safety issues. They examine and approve machinery with regard to emissions standards, inspect facilities and grounds to identify and correct potential hazards, and provide technical advice to their organization regarding how best to handle environmental issues. When accidents or hazards occur, industrial safety and health engineers investigate their causes to prevent future recurrence of the issue. They frequently write reports detailing their findings, and are responsible for ensuring much of an organization's regulatory compliance.

Industrial safety and health engineer must have an extensive knowledge of engineering and technology, as well as a basic understanding of concepts of math and physics. They must have an intuitive grasp of systems and systems design, to predict and trace the results of an action to different parts of the system. A solid sense of safety and security are crucial, as is a clear familiarity with the laws and regulations governing the industry in which they work. They must have impeccable logic skills, and an excellent sense of problem solving and troubleshooting. Safety and health engineers should be superb communicators, with a focus on writing, speaking, and listening. Employees in this occupation typically have at least a bachelor's degree in environmental engineering or a similar field. They often have a master's degree, or even a Ph.D.

In the aftermath of September 11th, the rules and regulations governing the manufacturing industry increased dramatically in number and scope. As a result, industrial safety and health engineers must constantly upgrade their regulatory knowledge. In addition, they must coordinate and seek approval from regulators, so negotiation and political skills are becoming consistently more important.

11. SALES REPRESENTATIVES, WHOLESALE AND MANUFACTURING

Sales representatives are responsible for the negotiation for, and sale of, various manufactured goods. They must contact potential and existing customers to solicit orders, and recommend their organization's various products based on the customer's needs. They may be required to meet with customers to demonstrate products and features, and occasionally are required to return to the customer after purchase to assist in the installation, set up, and use of the new product. Sales representatives are responsible for a substantial amount of paperwork in the form of contracts and bills of sale.

Sales representatives must have intimate knowledge of the products they are selling. They should be consummate salespeople, with a focus on customer service and negotiation. Sales representatives should be excellent communicators, speaking and listening well. They should have excellent skills in critical thinking and social perceptiveness, and should be very persuasive. Rapid comprehension is very important to employees in this position. Employees in this occupation are usually required to have a bachelor's degree, though some employers will accept graduates of two-year colleges.

12. CHEMISTS

Chemists design and conduct various chemical experiments and analyses. Their focus can alternate from the fabrication of new products and knowledge to the testing of existing products for quality control purposes. Chemists induce, control, and observe chemical reactions. They prepare solutions or compounds to conduct tests. Depending on their field, chemists' tasks can vary widely. For instance, a chemist at a food manufacturer may test methods of preserving or storing food products. A chemist at a plastics manufacturer might work to create new polymers. Chemists may be required to write reports and technical papers detailing their work. Similarly, they often are required to read reports or paper written by others in the field.

Chemists must have an intimate knowledge of chemistry and scientific principles. They should have an excellent grasp of math and mathematical concepts, and should be effective writers and speakers. Chemists typically are good critical thinkers, and should have good ethical judgment. Solid deductive reasoning and logical thinking are crucial. Education for chemists varies. General laboratory workers may just need a bachelor's degree in chemistry or chemical engineering. Research scientists often are required to have a master's degree or a Ph.D.

Rapid technological advances in nearly every field of basic science have led to a rapidly increasing knowledge base for chemists. New and current chemists are constantly forced to upgrade their skills, either through continuing education at a university or similar environment or through contact with colleagues. Additionally, more than ever before, chemists must be intimately familiar with computers and electronics to do their job effectively.

13. ELECTRICAL AND ELECTRONICS REPAIRERS, COMMERCIAL AND INDUSTRIAL EQUIPMENT

Electrical and electronics repairers are responsible for the repair and testing of electrical equipment in a variety of industrial settings. The equipment can include transmitters, antennas, or other industrial controls. They are also responsible for the installation and adjustment of new equipment. Electrical and electronics repairers are required to calibrate and maintain their testing equipment. They must read and interpret blueprints, schematics, or other technical information to determine and correct possible problems.

Electrical and electronics repairers must have a tremendous familiarity with computers and electronics. Knowledge of basic math and physics is crucial, as is knowledge of engineering and design. They should be effective educators, to demonstrate the use of equipment and train others to operate it. In addition, employers demand troubleshooting and problem solving skills. Repairs must be good communicators, able to read and interpret work orders and directives, and explaining problems. They should have good systems knowledge and logical thinking skills, to anticipate future problems. Employees in this occupation are required to have a high school diploma or G.E.D. Trade school experience is often preferred, but many employers offer on-the-job training programs or apprenticeships for potential repairers.

This occupation's tasks increasingly are being combined with those of machinists, to form a far more complex job, usually just called mechanic. Mechanics are responsible for both electrical work and machining. Employees in this new occupation are faced with more complex knowledge demands, and must be willing to pursue continuing education to stay familiar with the most current technology.