

# **Manufacturing Task Force Report: Findings and Recommendations**

**Illinois Workforce Investment Board  
Manufacturing Task Force  
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**December 14, 2006**

## Introduction

The Illinois Workforce Investment Board (IWIB) established the Manufacturing Task Force on December 9, 2005 to develop recommendations for addressing the causes of worker shortages in manufacturing as documented in regional reports from the Critical Skill Shortages Initiative (CSSI). The task force was asked to focus on issues that required state level action. The IWIB requested that the task force present findings and recommendations at the September 2006 IWIB meeting.

This report summarizes the major findings and recommendations of the Manufacturing Task Force. The first section provides background information on the formation of the task force, task force meetings, and the major issues addressed. The second section summarizes the task force findings and recommendations and proposed next steps. This section begins with an overview of manufacturing and its major trends in Illinois and the most critical worker shortages. This section then presents the major recommendations on how to address these shortages in Illinois.

## Background

The Manufacturing Task Force was chaired by Chuck Anderson, UAW, and James Hefti, Advanced Technology Services. The task force included representatives from employers and labor unions representing different segments of manufacturing, community colleges, universities, secondary schools, and state education, workforce development and economic development agencies. Manufacturing task force members are listed in Appendix A.

The task force met five times between March 9, 2006 and August 9, 2006 and held a conference call on August 29, 2006 to review and approve the final draft report before submitting the report to the IWIB. The task force presented interim reports to the IWIB at the March and June 2006 meetings.

At the first meeting, the task force reviewed the CSSI findings on shortages and identified the major occupational clusters to address. The task force also reviewed CSSI findings on the root causes of shortages and identified five major issues to address:

1. Image of Manufacturing—Improving the image of manufacturing focusing on the message that manufacturing is a critical industry in Illinois and that manufacturers must compete on innovation.

2. K-12 Career Awareness and Guidance—improving the student and parent awareness of career opportunities in manufacturing and expanding career guidance and exploration in K-12 schools.
3. Improving Workplace Skills---improving the basic workplace skills of entry-level production workers.
4. Improving Workforce Pipelines—improving the capacity and alignment of the workforce pipeline including P-20 alignment and integration of leading public-private training models and credentialing systems.
5. Continuous Learning—Engaging incumbent workers to recognize the need for continuous learning and training.

At the second meeting, the task force addressed each of the five major issues and discussed approaches and options in addressing these issues. The most attention was focused on the need for a statewide image and career awareness campaign and for developing improved workforce pipelines. At the third meeting, the task force reviewed draft findings and recommendations for an image campaign and building regional workforce pipelines. The task force also discussed how regional pipeline solutions must address the basic workplace skills of entry-level production workers through both foundation and bridge programs. At the fourth meeting, the task force focused on developing recommendations on K-12 career awareness and guidance based on a presentation by the Illinois State Board of Education. The task force also revised the recommendations on building regional pipelines after reviewing the U.S. Department of Labor's Advanced Manufacturing Framework of Competencies, receiving information on an Illinois Community College Board project to explore leading national manufacturing program models and receiving a brief overview of secondary programs. They also reviewed recommendations on the image campaign after being briefed on the Innovate Now initiative. The fifth meeting focused on reviewing the proposed recommendations for K-12 career awareness, the proposed themes and supporting data for an overview of manufacturing in Illinois, and the revised recommendations on improving the image of manufacturing and building regional workforce pipelines. The fifth meeting also focused on reviewing the workforce pipeline figure developed by Michael Cermak from Rock Valley College. The sixth and final meeting was conducted by conference call. The task force members reviewed the draft report including all recommendations and made final changes.

## Findings and Recommendations

Manufacturing remains a large and important sector in the Illinois economy, as measured by share of gross state product, and is projected to continue to provide strong employment opportunities throughout Illinois. These current and projected trends combined with rising skills requirements and the aging of the workforce will continue to create major shortages of skilled workers. The Critical Skill Shortages Initiative (CSSI) identified significant shortages in: (1) engineering technicians, (2) machinery maintenance, (3) manufacturing production (e.g., machinists, welders, assemblers, fabricators), and (4) supervisors and managers.

Because of the importance of manufacturing to the state economy, Illinois must take immediate actions to address these worker shortages. The Critical Skill Shortages Initiative (CSSI) and related state and regional efforts are an important first step in addressing these shortages. However, Illinois must now build on these state and regional initiatives. Illinois must take immediate actions to: (1) improve the image of manufacturing to attract youth and adults to pursue manufacturing careers, (2) build stronger regional workforce pipelines across the state, and (3) expand K-12 career development opportunities to prepare the future Illinois workforce.

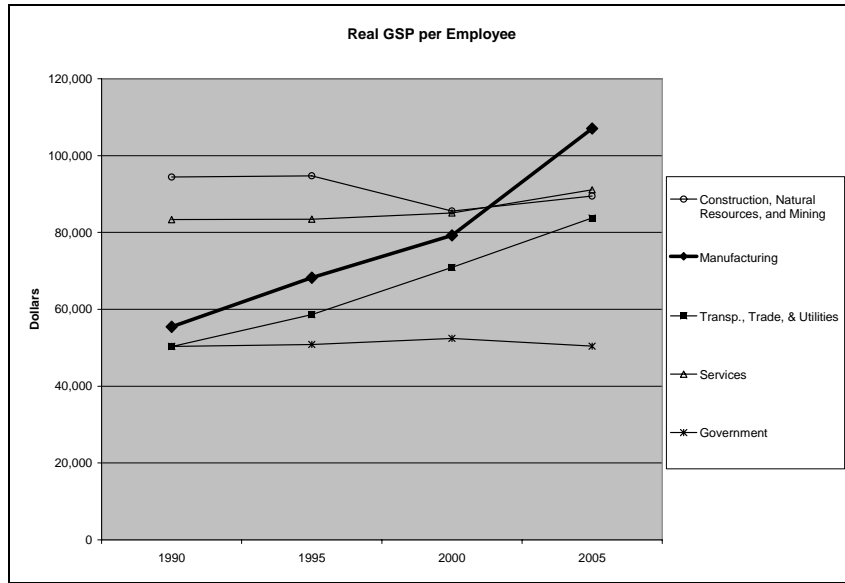
## Manufacturing in Illinois

Manufacturing Still Matters in Illinois. Manufacturing is a critical economic sector in Illinois because:

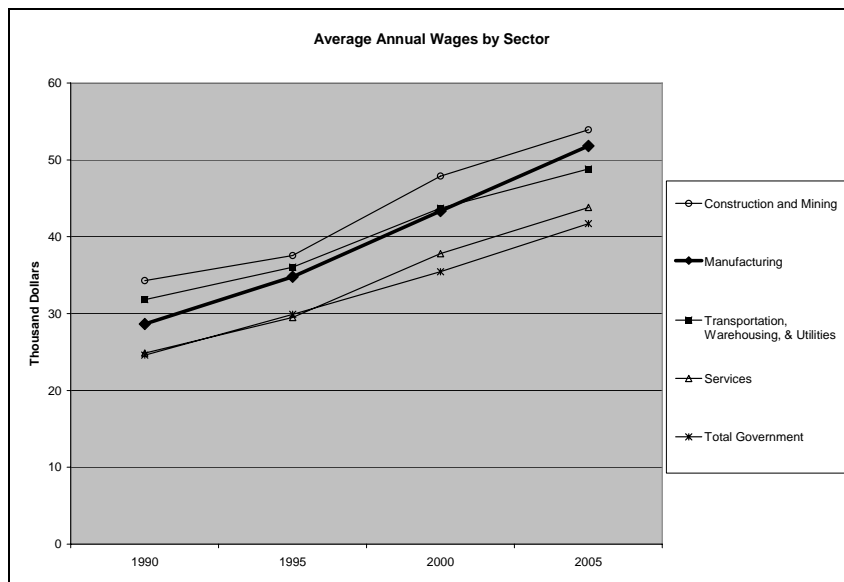
- Manufacturing is a large component of the state economy as measured by gross state product,
- Manufacturing continues to provide good wages and benefits to Illinois workers, and
- Manufacturing creates jobs in other sectors in Illinois because it purchases goods and services from other industries and employs workers with considerable spending power to purchase additional goods and services.

The manufacturing sector in Illinois continues to play a large role in shaping the economic activity of the state. Manufacturing in Illinois, as in the nation as a whole, has actually increased its share of economic activity as measured by Gross State Product (GSP) despite significant job losses. Over the last fifteen years, the manufacturing sector's share of non-farm employment and wages fell 5.5-6.0% (see Table 1 Employment in Appendix B). But during this same time period, the sector's share of Gross State Product (GSP), the measurement of all

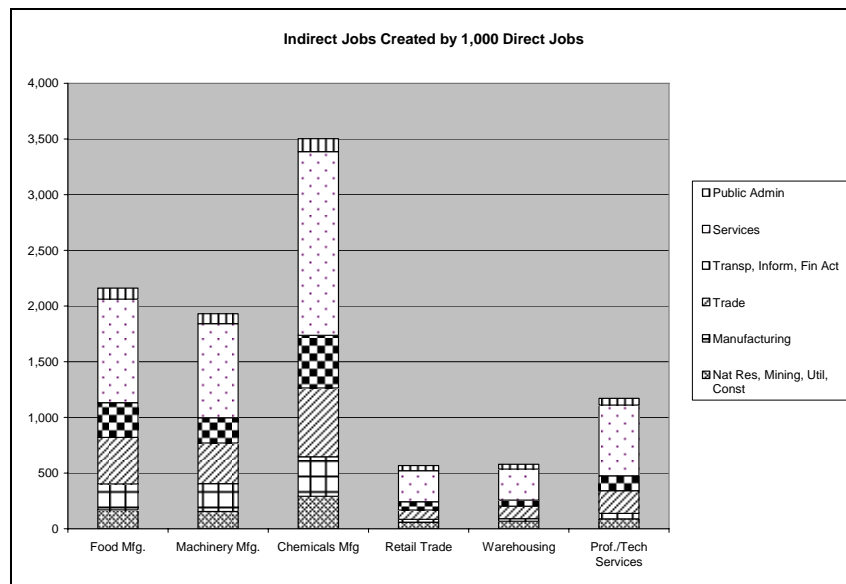
economic activity in the state's economy, actually increased (see Table 2 Gross State Product in Appendix B). The sector maintained and slightly increased its share of economic activity despite declining employment because of increased productivity. As shown in the chart below, compared to other industry sectors in the state, manufacturing experienced a rapid rise in productivity (GSP per employee)(see Table 3 Productivity in Appendix B). As shown in Appendix B, these trends in Illinois are consistent with national trends in manufacturing.



As shown in the chart below, the strong growth in productivity has contributed to substantial increases in wages. These wages have grown by 80% while the consumer price index increased by only 47% over the same period. This represents the biggest wage increase among all major industry sectors.



The large role of manufacturing in the state economy is also apparent in the numbers of jobs it creates in other sectors. For example, 1000 new chemical manufacturing jobs in Illinois would generate about 4,500 total jobs, 1000 direct jobs in the chemical industry and 3,500 indirect jobs in other industries. The chart to follow shows manufacturing sectors of Food, Machinery and Chemical provides double the indirect jobs of other sectors in the state's economy such as retail trade, warehousing, and professional and technical services. This indirect employment gained from manufacturing jobs affects the state's economy significantly in all the other of the state's industry sectors as show by chart below, the service sector gains nearly 40% of the indirect jobs created.



Manufacturing Is Changing in Illinois. The strong growth in productivity and output in face of significant job losses are the result, in part, of the major changes that are taking place in manufacturing industries and workplaces throughout Illinois and the world. To meet growing global competition and customer demands, Illinois manufacturers, like all manufacturers, are in the process of transforming themselves. They are introducing new global business strategies and business models, defining and entering new global markets, introducing new products and services, and developing and improving manufacturing processes. This transformation involves company mergers and acquisitions, global realignment and consolidation of production capacity, new business start-ups and expansions as well as plant closures, and expanded use of advanced technology and improvement approaches such as six sigma and lean manufacturing to reach world-class level quality and productivity. This transformation also involves the automation and outsourcing of low-skilled jobs and increases in the skill requirements of all workers ranging from managers, engineers, and technicians to front-line production workers.

In the future, Illinois manufacturers will increasingly compete on continuous and rapid innovation in business strategies and models, products and services, markets, and processes. This will continue to increase the skill requirements for all workers in manufacturing from managers and engineers to front-line production workers.

Manufacturing Has a Strong Future in Illinois. Manufacturing is projected to continue to grow in Illinois as measured by gross state product and will remain a significant share of the Illinois economy. In addition, manufacturing job loss is projected to level off creating strong employment opportunities for Illinois workers over the coming years.

The most recent economic projections for Illinois from Global Insight estimate that Manufacturing Gross State Product will increase annually 2.5% to 2010. Manufacturing average annual wage rate is also projected to increase by 19.5% over this period, which amounts to a 3.9% annual rate of change, which should exceed forecasted cost of living increases. Manufacturing productivity (value added per employee) is projected to increase 17.4% during this same period (see Table 9 Global Insight Projections in Appendix B).

This growth in output, wages, and productivity will be accompanied by a leveling off of jobs losses, which together will provide stronger employment opportunities for Illinois workers. The national economic recession which occurred during the early 2000s caused Illinois' manufacturing job losses to bottom out by 2002. Since then, job losses have steadily decreased and stabilized by 2005. Although there was a loss of more than 180,000 manufacturing workers between 2000 and 2005, recent government figures indicate the smallest annual number of manufacturing jobs were lost between 2004 and 2005 (8,000) representing a 1.1% loss in employment. Projections from Global Insight indicate that losses will continue to level off with projected losses of nearly 31,000 jobs forecasted between 2005 and 2010. This is 0.9% average annual loss during this five year time period.

## **Critical Worker Shortages**

The Critical Skill Shortages Initiative (CSSI) identified manufacturing as a key sector in most regions in Illinois and identified critical worker shortages in four major occupational areas: (1) engineering technicians, (2) machinery maintenance, (3) manufacturing production (e.g., CNC operators, machinists, welders, assemblers, fabricators), and (4) supervisors and managers (See Table 1 in Appendix C). The largest shortages were found in production occupations. These shortages were the result of both new job growth and the need to replace workers who left manufacturing companies, including those workers entering retirement.

These shortages are likely to worsen in the coming years because of strong projected growth in manufacturing combined with rising skills requirements and the aging of the workforce. If projections hold, Illinois will face a major challenge in upgrading the skills of current workers and replacing the large number of skilled workers likely to retire over the next few years.

## **Improving the Image of Manufacturing**

National studies by the National Association of Manufacturers and others have found that one of the major reasons for skill shortages in manufacturing is the poor image of the industry. The general public and potential job seekers think manufacturing is on the decline. They believe that manufacturing is not critical to the future of the national economy and will no longer provide good career opportunities. There also is a lack of knowledge about how manufacturing has changed and how this has increased skill requirements at all levels from managers and engineers to front-line production workers.

Illinois is no different. CSSI consortia in all regions of Illinois found that the poor image of manufacturing is one of the major root causes of skill shortages in manufacturing in Illinois. There is a common perception among public officials and potential job seekers that manufacturing is on the decline in Illinois and can no longer provide good career opportunities. There also is limited understanding of how manufacturing is changing and the need for higher skills.

Future efforts by employers, colleges, and schools to recruit and prepare more adults and youth to fill identified shortages will not be successful without a major change in the image of manufacturing in Illinois.

## **Recommendations**

Illinois should launch a public-private statewide campaign to improve the image of manufacturing to the general public and potential job seekers. This image campaign should provide a realistic and balanced perspective on manufacturing that recognizes that manufacturing is undergoing major transformations but that manufacturing will continue to provide good career opportunities in the future, especially during a period in which many skilled workers will be retiring. This campaign should emphasize that Illinois manufacturers are increasingly competing on innovation---business models, markets, products and processes. And, potential job seekers will need higher skills to help Illinois manufacturers compete and to be successful in manufacturing careers of the future. This statewide campaign should be coordinated with the larger Innovate Now



campaign that will be promoting innovation across all sectors including manufacturing.

Objectives. The objectives of the image campaign should be to:

- Expand awareness among community leaders, public officials, and the general public of the continued importance of manufacturing to the Illinois economy, how manufacturing is changing, how manufacturers are competing in the global economy, and why manufacturers are facing a serious skill shortage.
- Expand awareness of career opportunities in manufacturing among youth and adults and K-12 students and their parents

Key Themes. The key themes of the image campaign should be:

- Manufacturing is undergoing a major transformation but remains a critical component of the Illinois economy in terms of both output and jobs.
- Illinois manufacturers are increasingly competing on innovation---business models, markets, products and processes. They will compete on constantly improving everything they do across the entire business.
- Illinois manufacturers need skilled workers who can work with others to continuously improve products and processes.
- Illinois manufacturers will continue to provide these skilled workers with good career opportunities at all levels from managers and engineers to front-line workers.

Key Audiences. The image campaign should target the general public as well as job seekers. The campaign should focus on state and local public and private leaders, especially public elected officials. Job seekers should include all adults and youth. The targeted youth market should include K-12 students, out-of-school youth, and others within the 18 to 35-age range as well as their parents. The targeted adult market should include displaced workers and others making career transitions.

Regional Manufacturing Consortia. The image campaign should be launched on a regional basis through regional manufacturing consortia that build from existing CSSI consortia. These consortia should have representation from employers, unions, secondary and postsecondary education, economic development, and workforce development. These consortia should be supported by regional coordinators who are dedicated to managing the regional campaigns. These regional manufacturing consortia should be part of any future regional partnerships formed in the Innovate Now initiative.

Regional Campaign Activities. The regional consortia should plan and implement the following campaign activities.

- Promote regional and local forums and meetings with media coverage
  - Chamber and economic development meetings
  - Workforce board and university/community college meetings
  - Employer-hosted open houses and events
- Promote regular manufacturing news and information in regions
  - New markets, products, processes in existing employers
  - Employer expansions
  - New employers coming to region
  - Recognition of employees
- Promote careers and employment and education opportunities
  - K-12 career development
  - Career/job fairs and events

Statewide Coordination and Resources. The image campaign in each region should be supported by a statewide coordinator and advisory group. The image campaign should be provided with sufficient resources to support a campaign website and related printed materials. The campaign web site should be linked to and supported by Illinois workNet to ensure linkage with existing career and educational information. The image campaign at the state and regional levels should link to and leverage existing national resources such as the National Association of Manufacturers' Dream It Do It campaign wherever possible.

- Develop campaign web site with state and regional information
  - Facts and figures on manufacturing in Illinois and each region.
  - Competing on innovation---examples of how manufacturers are competing on innovation across the entire business (based on innovation framework emphasizing business models, markets, products, processes
  - Profiles of employers and their employees (10-20 per region)
    - Employer overview
    - Examples of innovation based on innovation framework
    - Virtual tour of company highlighting major functions, education needed to perform these functions, and the look and feel of a modern manufacturing facility (what is inside walls)
    - Profiles of workers filling critical jobs that provide information on what they do and how they got there. These profiles should be consistent with career development materials and the career areas highlighted.
  - Career and educational opportunities (linked to Illinois workNet)

- Career information consistent with K-12 career development materials
  - Highlighted career opportunities/jobs of employers
  - Education and training opportunities organized within a format that conveys a seamless sequence of programs within the regional pipeline model recommended by the IWIB Manufacturing Task Force.
- Develop printed campaign materials based on website content that can be customized by region. These materials should be designed for use in public forums and meetings with public and private stakeholders and in promoting careers with potential job seekers.

## **Building Regional Workforce Pipelines**

Illinois is facing severe shortages at all levels ranging from entry-level production workers to skilled workers and technicians with specialized skills such as welding, machining, maintenance, and engineering technology.

There is a need to develop comprehensive regional workforce pipeline solutions that address the following industry needs:

Improving Basic Workplace Skills. Employers have identified major shortages in basic workplace skills for entry-level production jobs that require only short-term training. Some regions have developed bridge programs that provide non-school youth and adults with opportunities to gain basic workplace skills, improve reading and math skills, and learn about career opportunities in manufacturing. These bridge programs are designed to prepare job seekers for entry into postsecondary credit programs and/or entry-level production jobs.

Expanding Manufacturing Foundation Programs. The largest projected shortages are in manufacturing production jobs that do not require long-term specialized training. Some regions are developing foundation programs to address this need. The Illinois Department of Commerce and Economic Opportunity recently funded the development of Manufacturing Boot Camps. Rock Valley College in cooperation with other colleges in the Northern Stateline Region recently developed a Certified Manufacturing Assistant Program. The CSSI effort in the Southern Economic Development Region launched the Work Certified program to provide workers with similar foundation skills. CSSI efforts in other regions are addressing similar needs. These foundation programs generally require participants to have strong basic reading and math skills at entry to ensure that the participants can successfully achieve the necessary technical and workplace

skills upon completion of the program. As a result, many regions will need bridge programs to provide the opportunity for some job seekers to qualify to enter foundation programs.

Promoting New Approaches for Specialized Training. The CSSI identified some common shortage areas that required significant long-term training. These involve four major areas: (1) manufacturing production (2) industrial maintenance, (3) engineering technicians, and (4) managers and supervisors. To address these needs, each region must: (1) identify the specialized training areas with the highest demand and (2) develop innovative public-private approaches to provide this training. Specialized training areas could be defined in terms of both processes and products. For example, specialized training could be defined in terms of specific manufacturing processes such as machining, assembly, chemical process operations, and biotechnology operations. It also could be defined in terms of specific types of products such as furniture, communication equipment, boats and related watercraft, and industrial machinery. Some regions are developing innovative program solutions to address shortages in these specialized training areas. For example, Danville Area Community College has developed an open-entry, open-exit model that has resulted in increased enrollment in welding and machining. The college is also using on-line learning systems. Other regions are exploring how to deliver regional programs and integrate classroom and on-the-job training. Others are exploring how to better use customized and incumbent worker training. There are also national model programs and resources that should be explored to address the needs for specialized training. Future efforts should explore how to better integrate public and private resources. Comprehensive regional pipeline solutions should be designed to provide multiple access points to job seekers to enter specialized training directly or through bridge and/or foundation programs.

Linking to K-12 Career Development and Career and Technical Education Programs. This three-tier model for building regional workforce pipelines must be integrally linked to career development programs in K-12 schools that begin with career awareness and exploration and lead to enrollment in secondary career and technical education programs. Illinois has established many new manufacturing and pre-engineering programs such as Project Lead The Way and Engineering By Design that should be integrated with existing programs within a career clusters framework based on the national Manufacturing Career Clusters model which is consistent with the national Department of Labor's competency model. This framework provides a unique opportunity to align secondary and postsecondary curriculum and explore dual credit opportunities.

## **Recommendations**

Illinois should further develop a regional workforce pipeline model that integrates and aligns bridge, foundation, and specialized training programs and provides linkages to K-12 career development and career and technical education. A model of this regional workforce pipeline is shown in Appendix D. This effort should integrate leading national models including the Advanced Manufacturing Competency Model recently developed by the U.S. Department of Labor and the Manufacturing Career Cluster model developed by the U.S. Department of Education and the state directors of career and technical education. Illinois should use the pipeline model to identify and develop leading models for manufacturing bridge programs, foundation programs, and specialized training programs and promote related programs in secondary career and technical education.

Illinois should promote the comprehensive regional implementation of these program models within regional pipeline solutions that allow regions to customize and tailor these program models to meet regional needs. However, all regions should be encouraged to develop comprehensive regional pipelines that align all three types of programs—bridge programs, foundation programs, and specialized training programs—and secondary career and technical education within a seamless system.

The implementation of these regional pipeline solutions should be guided by the regional manufacturing consortia conducting the manufacturing image campaign. These regional manufacturing consortia should use the regional workforce pipeline model and related bridge, foundation and specialized program models to conduct a systematic baseline inventory of secondary and postsecondary education programs at the statewide and regional levels and evaluate the alignment of these programs to ensure seamless transitions between programs and into the workforce. This inventory should include all types of publicly funded and regulated programs including programs offered by public and private universities, community colleges, community-based organizations, proprietary schools, and high schools. It also should include private training programs wherever possible including union apprenticeship and training programs.

These regional consortia should then use this baseline inventory to conduct a gap analysis to determine whether their regions have the right size and mix of programs to address projected demand, supply and shortages for the four identified shortage occupational areas and additional occupational areas specific to the region. This gap analysis should then be used to plan and develop new programs at all three tiers. These regional efforts also should be used to promote the exchange of information and program models between regions and

provide recommendations for expanding statewide program capacity and improving alignment.

### **Career Awareness and Guidance**

CSSI consortia in all regions of Illinois identified the need to expand career awareness and guidance opportunities for K-12 students. Students and their parents should be given the opportunity to fully understand the career opportunities in manufacturing and how to develop career and education plans to pursue these careers. The proposed image and career awareness campaign is only the first step. Illinois must also provide structured opportunities for K-12 students to explore careers and develop career and education plans to pursue career in manufacturing as well as other career fields. Any future effort to expand career development opportunities in Illinois should be part of a larger effort to establish a comprehensive career development system in schools in which students can explore and plan for all careers.

This will be a major challenge in Illinois. Schools currently do not have the staff and resources necessary to provide these opportunities. Career guidance staff cannot be expected to provide these opportunities because of existing priorities and resources. In addition, teachers do not have the resources and support to provide these career development opportunities in classrooms. There is also no existing statewide effort by the manufacturing industry to partner with schools to provide these career development opportunities. Finally, there is limited time in the school curriculum for career development because of increased focus on academic preparation and increased graduation requirements. As a result, any effort at expanding career development must be designed so career development can be fully embedded into and linked to existing academic courses and career and technical education programs.

The Health Sciences K-12 Career Clusters model provides a promising starting point for developing a comprehensive system for career development in Illinois and a more focused effort to provide opportunities to expand career awareness and exploration opportunities in manufacturing. The Illinois State Board of Education is now developing career development materials in cooperation with other states based on the national Manufacturing Career Clusters model (See Appendix E), which is consistent with the U.S. Department of Labor's competency model. This effort also is based on the successful Health Sciences model that was endorsed by the IWIB Healthcare Task Force. These career development materials also provide the opportunities for students to strengthen their academic skills through their application in career development projects and scenarios. Illinois also has universities and community colleges who are actively engaging K-12 teachers and students in career development activities. All of

these efforts should be the foundation for expanding career development opportunities in manufacturing in Illinois.

### **Recommendations**

Illinois should develop and implement a comprehensive career development system for K-12 education that provides students and their parents with career awareness, exploration and preparation opportunities at each critical stage of education, especially at key points of transition between elementary school and middle school, middle school and high school, and high school and postsecondary education.

As part of this effort, Illinois should develop and implement a comprehensive career development program for manufacturing. This effort should start with providing middle school and lower high school students with the opportunities to explore manufacturing careers and develop career and education plans for high school and postsecondary education and training. This effort should engage the leading manufacturers actively involved in the image campaign at the state and regional levels as well as university and community college partners. This effort should then be expanded to other critical points of transitions for students.

Illinois should continue to work with other states in creating career development curriculum materials based on the national Manufacturing Career Clusters framework and the successful Health Sciences career development model. Illinois should pilot test these materials in 2-3 regions within the next year. Illinois should then develop a plan to expand and sustain this career development expand these efforts to reach all regions in Illinois.

### **Conclusions and Next Steps**

Manufacturing remains critical to the Illinois economy. Manufacturing is facing major problems in attracting sufficient numbers of skilled workers to meet current and future needs. The Critical Skill Shortages Initiative (CSSI) identified significant shortages in: (1) engineering technicians, (2) machinery maintenance, (3) manufacturing production (e.g., machinists, welders, assemblers, fabricators), and (4) supervisors and managers. These shortages are likely to increase over the next few years because of projected output growth in the manufacturing sector, rising skill requirements, and the need to replace a large number of workers entering retirement.

Illinois must take immediate actions to address these worker shortages. The Critical Skill Shortages Initiative (CSSI) and related state and regional efforts are an important first step in addressing these shortages. However, Illinois must

now build on these initiatives and take immediate actions to implement the Manufacturing Task Force recommendations to: (1) improve the image of manufacturing to attract youth and adults to pursue manufacturing careers as well as persuade parents to view manufacturing as a viable career for children, (2) build stronger regional workforce pipelines across the state, and (3) expand K-12 career development opportunities to prepare the future Illinois workforce.

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## **Appendix A**

### **Illinois Workforce Investment Board Manufacturing Task Force**

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## **Appendix B**

### **Manufacturing in Illinois**

Table 1: Manufacturing Employment 1990-2005

Table 2: Manufacturing Gross State Product, 1990-2005

Table 3: Manufacturing Productivity, 1990-2005

### Table 1: Employment

Manufacturing Employment 1990-2005

Illinois: Global Insight

US: Moody's

	1990	1995	2000	2005
Illinois:Manufacturing Share of Nonfarm Employment %	17.3	16.0	14.4	11.8
US:Manufacturing Share of Nonfarm Employment %	16.2	14.7	13.1	10.7
Illinois:Manufacturing Employment	914772	893586	870577	689383
US:Manufacturing Employment	17695000	17244000	17266000	14234000

### Table 2: Gross State Product

Manufacturing Gross State & Domestic Product 1990-2005

Illinois: Global Insight

US: Moody's

	1990	1995	2000	2005
Illinois:Manufacturing Share of Gross State Product %	14.3	15.2	14.9	14.7
US:Manufacturing Share of Gross Domestic Product %	17.8	15.9	12.4	10.7
Illinois:Manufacturing Gross State Product ( millions 2000 \$)	50728	60955	68990	73816
US:Gross Domestic Product ( millions 2000 \$)	1033280	1175660	1426240	1547600

### Table 3: Productivity

Statewide Manufacturing Productivity 1990-2005

Illinois: Global Insight

US: Moody's

	1990	1995	2000	2005
Illinois:Manufacturing Productivity(GSP/Emp\$)	55,454	68,213	79,246	107,075
US:Manufacturing Productivity(GDP/Emp\$)	58,394	68,236	82,604	108,726

## **Appendix C**

### **Manufacturing Shortage Occupations**

**Table 1 State CSSI Manufacturing Clusters**

**Table 2 Production Occupations Classified By  
Process Specialization**

## Table 1 State CSSI Manufacturing Clusters

1 Cluster	Engineering Technicians
17-3021	Aerospace Engineering and Operations Technicians
17-3023	Electrical and Electronic Engineering Technicians
17-3024	Electro-Mechanical Technicians
17-3025	Environmental Engineering Technicians
17-3026	Industrial Engineering Technicians
17-3027	Mechanical Engineering Technicians
2 Cluster	Machinery Maintenance
49-2092	Electric Motor, Power Tool, and Related Repairers
49-2093	Electrical and Electronics Installers & Reprs, Trans Equipment
49-2094	Electrical & Electronics Reprs, Commercial & Industrial Equipment
49-9012	Control & Valve Installers & Repairers, Exc. Mechanical Door
49-9041	Industrial Machinery Mechanics
49-9042	Maintenance and Repair Workers, General
49-9043	Maintenance Workers, Machinery
49-9044	Millwrights
3 Cluster	Manufacturing Production
51-2021	Coil Winders, Tapers, and Finishers
51-2022	Electrical and Electronic Equipment Assemblers
51-2023	Electromechanical Equipment Assemblers
51-2031	Engine and Other Machine Assemblers
51-2041	Structural Metal Fabricators and Fitters
51-2091	Fiberglass Laminators and Fabricators
51-2092	Team Assemblers
51-2093	Timing Device Assemblers, Adjusters, and Calibrators
51-4011	Computer-Controlled Machine Tool Operators, Metal & Plastic
51-4012	Numerical Tool and Process Control Programmers
51-4021	Extruding & Drawing Mach Setters, Ops, & Tndrs, Metal and Plastic
51-4022	Forging Machine Setters, Operators, & Tenders, Metal & Plastic
51-4023	Rolling Machine Setters, Operators, & Tenders, Metal & Plastic
51-4031	Cutting, Punching, & Press Mach Sttrs, Ops & Tndrs, Metal & Plast
51-4032	Drilling & Boring Mach Tool Sttrs, Ops, & Tndrs, Metal & Plastic
51-4033	Grinding, Lapping, Polishing, & Buffing Mach Tool Sttrs, Ops & Tndrs
51-4034	Lathe & Turning Mach Tool Sttrs, Ops & Tndrs, Metal & Plastic
51-4035	Milling & Planing Mach Sttrs, Ops & Tndrs, Metal & Plastic
51-4041	Machinists



- 3 Cluster      Manufacturing Production continued
  - 51-4051      Metal-Refining Furnace Operators and Tenders
  - 51-4052      Pourers and Casters, Metal
  - 51-4061      Model Makers, Metal and Plastic
  - 51-4062      Patternmakers, Metal and Plastic
  - 51-4071      Foundry Mold and Coremakers
  - 51-4072      Molding, Coremaking, & Cstng Mach Sttrs, Ops & Tndrs, Metal & Plast
  - 51-4081      Multiple Machine Tool Setters, Operators, & Tenders, Metal & Plast
  - 51-4111      Tool and Die Makers
  - 51-4121      Welders, Cutters, Solderers, and Brazers
  - 51-4122      Welding, Soldering, & Brazing Machine Setters, Ops & Tndrs
  - 51-4191      Heat Treating Equipment Setters, Ops & Tndrs, Metal & Plast
  - 51-4192      Lay-Out Workers, Metal and Plastic
  - 51-4193      Plating & Coating Mach Setters, Ops & Tndrs, Metal & Plastic
  - 51-4194      Tool Grinders, Filers, and Sharpeners
  - 51-9111      Packaging and Filling Machine Operators and Tenders
  - 51-9121      Coating, Painting, & Spraying Machine Setters, Ops & Tndrs
  - 51-9122      Painters, Transportation Equipment
  - 51-9123      Painting, Coating, and Decorating Workers
  - 51-9141      Semiconductor Processors
  - 51-9191      Cementing and Gluing Machine Operators and Tenders
  - 51-9192      Cleaning, Washing, & Metal Pickling Equipment Ops & Tndrs
  - 51-9193      Cooling and Freezing Equipment Operators and Tenders
  - 51-9195      Molders, Shapers, and Casters, Except Metal and Plastic
  - 51-9196      Paper Goods Machine Setters, Operators, and Tenders
  - 51-9197      Tire Builders
  
- 4 Cluster      Supervisors and Managers
  - 11-3051      Industrial Production Managers
  - 49-1011      First-Line Supvrs/Mgrs of Mechanics, Installers, & Repairers
  - 51-1011      First-Line Supvrs/Mgrs of Production & Operating Wkrs

**Table 2**  
**Production Occupations Classified by Process Specialization**

Manufacturing Production Occupations by Training Requirements & Earnings				2002 median annual earnings
Code	Occupation title	On-the-Job training	Educational Attainment	Dollars
<b>Assembly</b>				
51-2022	Electrical and electronic equipment assemblers	Short-term	HS/SC	22,940
51-2023	Electromechanical equipment assemblers	Short-term	HS/SC	25,260
51-2031	Engine and other machine assemblers <sup>1</sup>	Short-term	HS/SC	29,170
51-2092	Team assemblers	Moderate-term	HS/SC	22,680
51-2041	Structural metal fabricators and fitters	Moderate-term	HS/SC	28,620
<b>Machining</b>				
51-4011	Computer-controlled machine tool operators	Moderate-term	HS/SC	29,050
51-4041	Machinists	Long-term	HS/SC	32,570
51-4111	Tool and die makers	Long-term	HS/SC	42,730
51-4031	Cutting, punching, and press machine *	Moderate-term	HS/SC	24,570
51-4032	Drilling and boring machine tool setters*	Moderate-term	HS/SC	27,530
51-4033	Grinding, lapping, polishing, and buffing mach tool *	Moderate-term	HS	26,120
51-4034	Lathe and turning machine tool *	Moderate-term	HS/SC	30,270
51-4081	Multiple machine tool setters, operators & tenders	Moderate-term	HS/SC	28,690
<b>Welding</b>				
51-4121	Welders, cutters, solderers, and brazers	Long-term	HS/SC	29,160
51-4122	Welding, soldering, and brazing machine setters*	Moderate-term	HS/SC	28,900
<b>Forming</b>				
51-4021	Extruding and drawing machine setters, operators*	Moderate-term	HS/SC	25,870
51-4022	Forging machine setters, operators, and tenders	Moderate-term	HS/SC	26,300
51-4023	Rolling machine setters, operators, and tenders	Moderate-term	HS	28,330
51-4072	Molding, coremaking, and casting machine strs*	Moderate-term	HS/SC	23,230
51-4193	Plating and coating machine setters, operators*	Moderate-term	HS	25,420
51-9041	Extruding, forming, pressing, and compacting mach*	Moderate-term	HS/SC	26,540
<b>Printing</b>				
51-5023	Printing machine operators	Moderate-term	HS/SC	29,010
51-5011	Bindery workers	Short-term	HS/SC	21,860
51-5021	Job printers	Long-term	HS/SC	30,100
51-5022	Prepress technicians and workers	Long-term	HS/SC	31,150
<b>Textiles</b>				
51-6031	Sewing machine operators	Moderate-term	HS	17,440
51-6021	Pressers, textile, garment, and related materials	Short-term	HS	17,070
51-6051	Sewers, hand	Short-term	HS/SC	18,070

## Chemicals

51-8031	Water and liquid waste treatment plant and system op	Long-term	HS/SC	33,390
51-9011	Chemical equipment operators and tenders	Moderate-term	HS/SC	37,430

## Food

51-3011	Bakers	Long-term	HS/SC	20,580
51-3021	Butchers and meat cutters	Long-term	HS	25,500
51-3022	Meat, poultry, and fish cutters and trimmers	Short-term	HS	17,820
51-3023	Slaughterers and meat packers	Moderate-term	HS	20,370
51-3092	Food batchmakers	Short-term	HS	21,920
51-9023	Mixing and blending machine setters, operators*	Moderate-term	HS/SC	27,530

\* occupations will include Operators, Setters & Tenders

Short-term on-the-job training: 1 month or Less

Moderate-term on-the-job training: 1 to 12 months

Long-term on-the-job training: 12 or more months in Classroom

<sup>1</sup> The job types are presented in the following categories: HS = high school occupations,

HS/SC = high school/some college occupations, SC = some college occupations,

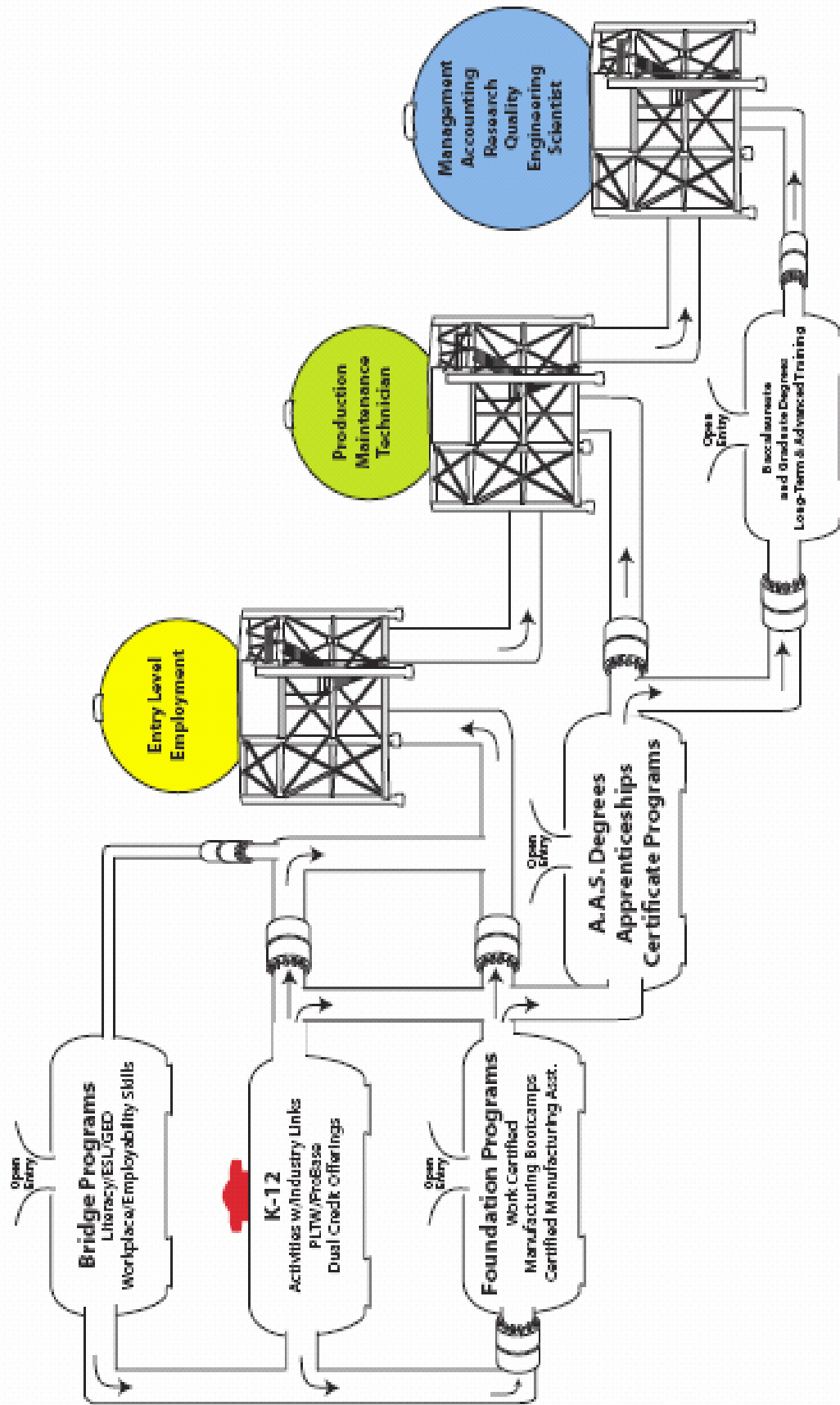
SC = some college occupations, HS/SC/C = high school/some college/college occupations,

SC/C = some college/college occupations

## **Appendix D**

### **Manufacturing Workforce and Education Value Stream Pipeline**

# Manufacturing Workforce & Education Value Stream Pipeline



A pdf of the pipeline can be obtained by contacting  
 Michael Carnall  
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 015.831.2784  
**Piedmont Valley College**

## **Appendix E**

### **Manufacturing Career Clusters Model**



# Manufacturing Cluster

**Planning, managing, and performing the processing of materials into intermediate or final products and related professional and technical support activities such as production planning and control, maintenance and manufacturing/process engineering.**

<b>Sample Career Specialties/Occupations</b>	<ul style="list-style-type: none"> <li>◆ Assemblers</li> <li>◆ Calibration Technicians</li> <li>◆ Electrical Installers and Repairers</li> <li>◆ Electromechanical Equipment Assemblers</li> <li>◆ Extruding and Drawing Machine Setters/Set-Up Operators</li> <li>◆ Extrusion Machine Operators</li> <li>◆ Foundry Workers</li> <li>◆ Grinding, Lapping, and Buffing Machine Operators</li> <li>◆ Hand Packers and Packagers</li> <li>◆ Instrument Makers</li> <li>◆ Large Printing Press Machine Setters and Set-Up Operators</li> <li>◆ Machine Operators</li> <li>◆ Managers, Supervisors</li> <li>◆ Medical Appliance Makers</li> <li>◆ Milling Machine Setters, Set-Up Operators</li> <li>◆ Operators, Tenders,</li> <li>◆ Pattern &amp; Model Makers</li> <li>◆ Precision Layout Workers</li> <li>◆ Precision Optical Goods Workers</li> <li>◆ Production Associates</li> <li>◆ Sheet Metal Workers</li> <li>◆ Solderers and Brazers</li> <li>◆ Tool and Die Makers</li> <li>◆ Welders</li> </ul>	<ul style="list-style-type: none"> <li>◆ Design Engineers</li> <li>◆ Electrical and Electronic Technicians and Technologists</li> <li>◆ Electronics Engineers</li> <li>◆ Engineering and Related Technicians and Technologists</li> <li>◆ Engineering Technicians</li> <li>◆ Industrial Engineers</li> <li>◆ Labor Relations Managers</li> <li>◆ Manufacturing Engineers</li> <li>◆ Manufacturing Technicians</li> <li>◆ Power Generating and Reactor Plant Operators</li> <li>◆ Precision Inspectors, Testers, and Graders</li> <li>◆ Process Improvement Technicians</li> <li>◆ Production Managers</li> <li>◆ Purchasing Agents</li> <li>◆ Supervisors</li> </ul>	<ul style="list-style-type: none"> <li>◆ Biomedical Equipment Technicians</li> <li>◆ Boilermakers</li> <li>◆ Communication System Installers/Repairers</li> <li>◆ Computer Installers/Repairers</li> <li>◆ Computer Maintenance Technicians</li> <li>◆ Electrical Equipment Installers/Repairers</li> <li>◆ Facility Electricians</li> <li>◆ Industrial Electronic Installers/Repairers</li> <li>◆ Industrial Facilities Managers</li> <li>◆ Industrial Machinery Mechanics</li> <li>◆ Industrial Maintenance Electricians</li> <li>◆ Industrial Maintenance Mechanics</li> <li>◆ Industrial Maintenance Technicians</li> <li>◆ Instrument Calibration and Repairers</li> <li>◆ Instrument Control Technicians</li> <li>◆ Job/Fixture Designers</li> <li>◆ Laser Systems Technicians</li> <li>◆ Maintenance Repairers</li> <li>◆ Major Appliance Repairers</li> <li>◆ Meter Installers/Repairers</li> <li>◆ Millwrights</li> <li>◆ Plumbers, Pipe Fitters and Steam Fitters</li> <li>◆ Security System Installers/Repairers</li> </ul>	<ul style="list-style-type: none"> <li>◆ Calibration Technicians</li> <li>◆ Inspectors</li> <li>◆ Lab Technicians</li> <li>◆ Process Control Technicians</li> <li>◆ Quality Control Technicians</li> <li>◆ Quality Engineers</li> <li>◆ SPC Coordinators</li> </ul>	<ul style="list-style-type: none"> <li>◆ Communications, Transportation and Utilities Managers</li> <li>◆ Dispatchers</li> <li>◆ Freight, Stock, and Material Movers</li> <li>◆ Industrial Truck and Tractor Operators</li> <li>◆ Logistical Engineers</li> <li>◆ Logisticians</li> <li>◆ Material Associates</li> <li>◆ Material Handlers</li> <li>◆ Material Movers</li> <li>◆ Process Improvement Technicians</li> <li>◆ Quality Control Technicians</li> <li>◆ Traffic Managers</li> <li>◆ Traffic, Shipping, and Receiving Clerks</li> </ul>	<ul style="list-style-type: none"> <li>◆ Environmental Engineers</li> <li>◆ Environmental Specialists</li> <li>◆ Health and Safety Representatives</li> <li>◆ Safety Coordinators</li> <li>◆ Safety Engineers</li> <li>◆ Safety Team Leaders</li> <li>◆ Safety Technicians</li> </ul>
<b>Path Ways</b>	<b>Production</b>	<b>Manufacturing Production Process Development</b>	<b>Maintenance, Installation &amp; Repair</b>	<b>Quality Assurance</b>	<b>Logistics &amp; Inventory Control</b>	<b>Health, Safety and Environmental Assurance</b>
<b>Cluster K &amp; S</b>	<p><b>Cluster Knowledge and Skills</b></p> <ul style="list-style-type: none"> <li>◆ Academic Foundations ◆ Communications ◆ Problem Solving and Critical Thinking ◆ Information Technology Applications ◆ Systems</li> <li>◆ Safety, Health and Environmental ◆ Leadership and Teamwork ◆ Ethics and Legal Responsibilities</li> <li>◆ Employability and Career Development ◆ Technical Skills</li> </ul>					