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# INTRODUCTION

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## **Manufacturing Success in Texas**

Tony Bennett, president of the Texas Association of Manufacturers, recently spoke about the business environment in the state and various issues affecting the vitality and future of our manufacturing sector as follows.

For many years now, Texas has had the reputation of being heaven on earth for manufacturers. We have inexpensive energy, very efficient access to global markets and the ports along the Texas coast to help us get our products anywhere in the world.

Texas is located in the center of the country and that brings efficiency to logistics and supply chain issues. We have low taxes and we have sensible regulation. Our Texas Universities have strong graduation rates, which is encouraging for our workforce needs. There are some gaps in workforce demands and the industry is working closely with community colleges, to help prepare the future workforce for the high-quality jobs manufacturers have to offer.

It appears that Texas will continue to offer pro-business politics for many years to come and our business environment has become the envy of other states and many countries around the world.

It is costly to move parts to a plant for manufacturing and final assembly and to take that product and deliver it to the customer. Texas has a geographic advantage because we are located in the center of the United States, and also in the center of North America. Our state's number one trading partner is Mexico with Canada,

second giving an advantage to being located in the middle of the best market in the world. Manufacturers and suppliers can deliver goods and supplies to the many Texas airports, and we have access to ports in Corpus, Houston, and Beaumont allowing distribution of products anywhere in the world.

We are also seeing more re-shoring or on-shoring – bringing back jobs that used to be in China and other places overseas. Many of those jobs come back to North American and to Texas.

Advanced manufacturing technologies are in many of today's processes with robotics, nanotechnology, micro-electromechanical systems and 3-D printers being found in nearly every sector and region of our state's manufacturing economy. There will be a retrofitting of fabrication plants all over the world with equipment in fabricating industries needing to be modernized.

Manufacturers need many different skilled workers including engineers, welders, electrical engineers, and assemblers of products. There is need of every kind of skill sets imaginable to fill the current need and to prepare for the retiring manufacturing workforce as baby boomers retire in big numbers over the next five to 10 years.

## **The Need for a Skilled Workforce**

In Texas, we have discovered a leak in the education pipeline between the number of students who enter into college and the number who exit, which results in costly

loss of expenditures and leads to a loss of skilled workers.

Since 1987, North Central Texas InterLink has been the leader in industry driven labor market forecasting for the North Central Texas region, to help influence the future of career and technical education programs at the secondary and post-secondary levels which prepares students for the workforce.

This report on the future trends of the Manufacturing Industry is the fourth in a series of reports produced by InterLink about future trends in specific industries to help guide educators and students toward the next wave of knowledge, skills and technologies for education programs and practices. Previous reports include Future Trends of Information Technology, Health Care and Construction Industries.

Subsequent reports will be published identifying the future trends of other industries.

We are fortunate to have industry partners involved with InterLink's Board of Directors who lead this endeavor, and participate as Industry Trends Task Force Leaders to identify the industries to be studied, and thought leader participants from varied companies.

This report identifies sixteen trends which were ranked in order by the Future Trends in Manufacturing Industry Thought Leaders, to help guide students in choosing a career and to assist educators with the development of curriculum.

Participants who provided this information want to recognize the following:

- The timeline for these trends is current and change will be dynamic and constant.
- Quality, safety and ethics are integrated into every facet of the Manufacturing Industry.

## METHODOLOGY

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The process used for this report was advancing foresight methodologies, using multiple techniques to aggregate expert opinions into the discipline of forecasting. By utilizing multiple sources of data collection such as forecast predictions, a thought leader work shop, an industry survey, and peer review, the Interlink task force was able to gather a comprehensive view of what industry leaders see as the future of the Manufacturing Industry.

InterLink's annual 26<sup>th</sup> Regional Employer Labor Market Five-Year Forecast began as a starting point. The research was enhanced by a workshop with North Texas Manufacturing Industry thought leaders from a diverse range of disciplines and professional backgrounds, engaging them in exercises to identify key drivers of change and how these will shape work skill requirements.

Thought Leaders were surveyed after the event for additional thoughts and input.

Finally, peer reviewers analyzed the results of the thought leader session to enrich and vet the research.

This structured and disciplined process will be followed for subsequent thought leader groups, as we research other industries, to ensure systematic and robust data collection.

It is with gratitude to InterLink's partner in this endeavor: TMAC, the InterLink Industry Trends Task Force Leaders, and the Manufacturing Industry Thought Leaders who made this study possible.

## PROJECT PARTNER ORGANIZATION

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**TMAC** is a Technical and Management Assistance & Consulting organization and part of the Manufacturing Extension Partnership hosted at the University of Texas at Arlington. TMAC accelerates the profitable growth of manufacturers by implementing methods, innovation, technology and best practices to develop and improve products, processes and people.

**MISSION:** To increase the global competitiveness of the Texas economy by working to grow the extended manufacturing enterprise.

[www.tmac.org](http://www.tmac.org) & [www.tmacdfw.org](http://www.tmacdfw.org)

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**INTERLINK** *Est. 1987*

**InterLink** is a nonprofit organization with 28 years of labor market and industry trend forecasting. InterLink acts as a bridge between business and education providing secondary and post-secondary education institutions in the Dallas/Fort Worth region industry driven forecasts for Career and Technical Education program planning and curriculum development to train a highly skilled and knowledgeable regional workforce.

[www.interlink-ntx.org](http://www.interlink-ntx.org)

# INTERLINK MANUFACTURING INDUSTRY TRENDS TASK FORCE MEMBERS

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**Chair: Tu Huynh**, Vice President, Infrastructure Technology Services, Comerica Bank  
**Vice Chair and Thought Leader Facilitator: Leon Kao**, Certified R6 $\sigma$  Expert, SAS  
Engineering North Texas Regional Lead, Raytheon  
**Dr. Rajamani Divakar**,  
Center for Intelligent Supply Networks at University of Texas at Dallas  
**Pat Boutier**, TMAC UTA  
**Lauren Turner**, TDIndustries  
**Candy Slocum**, InterLink

## MANUFACTURING INDUSTRY THOUGHT LEADERS

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**Curtis Clark**, Maxim Integrated  
**Vincente D’Ingianni**, ZNYX Networks, Inc.  
**Dr. Rajamani Divakar**,  
Center for Intelligent Supply Networks at University of Texas at Dallas  
**Wayne Funk**, Lockheed Martin MFC  
**Mark King**, MicroPac Industries  
**Lance Lifka**, Jostens  
**Jorge Medina Aller**, USA SHADE  
**Dixon Myers**, Anchor Fabrication  
**Lauren Turner**, TDIndustries  
**Pat Boutier**, TMAC UTA

## PEER REVIEWERS

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**Alberto Gutierrez**, L3 Communications  
**Rodney Allen**, SPG Manufacturing  
**Doug Van Zuiden**, PACCAR/Peterbilt

***Trend 1~ Automation (Data/Fabrication): The use of largely automatic equipment in a system of manufacturing or other production process.***

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## **Skills and Knowledge**

Additive Technology (3D Printing)

Automated CNC Programming

Automated Work Instruction Generation

Coordinate Measuring Machine (CMM) Programming

Diagnostic Technology

Drones

Ergonomics

Imbedded Software Design

Industrial Automation Security

Industrial Design

Information Technology

Ladder Logic Programming

Micro Electronics

Micro Machining

Person Machine Integration

RFID

Robotics

Simulation

**"Successful businesses of the future will focus on three areas:**

- 1) People and Culture Development**
- 2) Systems and Processes to make their people successful, and**
- 3) Developing business strategies to match product to market growth."**

**Mark King  
CEO and President  
Micropac Industries, Inc.**

***Trend 2 ~ General Manufacturing Skills:*** *Certain skills that employers expect employees to have to work in the Manufacturing Industry.*

(Note: Also see Entry Level Skills and Attributes for Entry Level Workers page 21)

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## **Necessary Skills and Knowledge**

Ability to measure/inspect hardware  
Additive Manufacturing (3D Printing)  
Basic understanding of computer programming  
Coordinate Measuring Machine (CMM) Operation  
Computer Numerical Control (CNC) Machining  
Drafting  
Engineering drawing/reading  
Geometric Dimensioning & Tolerancing  
Manufacturing Process Experience (hands on labs)  
Math  
Problem solving  
Robotic Operations /Set Up/Maintenance  
Soft Skills  
Spreadsheet Proficiency (i.e. Excel)  
Units Conversions  
Welding

***Prediction:*** *Although robotics, automation, and data processing will continue to drive the future of manufacturing; having tradespeople with specialized tool and die skills will never completely be removed.*



***Trend 3 ~ Improvement Process: The efficiency and effectiveness of process inputs and the quality of its outputs.***

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## **Necessary Skills and Knowledge**

3D Printing	Project Management
5S Workplace Organization/Management	Quality Control
Augmentation	Repeatability
Brainstorming	Robotics
Facilitation Skills	Root Cause Analysis
Global Standardization (ISO-AWS-CWD)	Scientific Method
Industrial Engineering	Six Sigma
Lean Six Sigma	Smart Sensors and Cameras
PDSA	Statistical Analysis
Person Machine Integration	Statistics
Predictive Maintenance	Time Management
Proactive Quality	Training Within Industry
Problem Solving	Value Stream Mapping



***Trend 4 ~ Workforce Mobility and Flexibility:*** *Workforce mobility impacts the way corporations operate as technology enables and powers the ability for employees to work from locations other than the workplace, while Flexibility enables both individual and business needs to be met through making changes to the time (when), location (where) and manner (how) in which an employee works.*

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## **Necessary Skills and Knowledge**

3D Printing

Artificial Intelligence

Cross Training

Culture

Flexibility/Agility

Geospatial Connectivity

Information Worker

Labor Centric Sourcing

Mobile Apps

Mobile Service Technicians

Multi-Discipline

Pervasive Connectivity

Predictive Maintenance

Problem Solving

Product Planning

Production Line Simulation

Project Management

Resource Scarcity Management

Robotics

Social Networking

System Thinking

Team Work Principles

Technology Skills

The Internet of Things

Training Within Industry

Virtualization

***Trend 5 ~ Natural Resource Management: Managing the way in which people and natural landscapes interact, bringing together land use planning, water management, biodiversity conservation, for future sustainability.***

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### **Necessary Skills and Knowledge**

Battery Technology

Green Facilities

Metal Reclamation

Photo Voltaic Technologies - solar panel

Power Management & Conservation

Recycle

Sustainability

Salvage

Water Treatment and Conservation

Wind Power Generation

**"The Manufacturing Industry bridges the gap between the Idea of things and the Reality of those things. Our job is to solve the problem of how to do this as quickly and as efficiently as possible while providing the most value to the customer"**

**Curtis Clark  
Supply Chain Manager  
Maxim Integrated**

***Trend 6 ~ Supply Chain Management:*** *The management of the flow of goods and services, including the movement and storage of raw materials, work-in-process inventory, and finished goods from point of origin to point of consumption.*

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### **Necessary Skills and Knowledge**

Autonomous Logistics Factory Vehicles

Data Management

Enterprise Resource Planning (ERP) Systems

Forecasting

Information Technology/Software

Integrated VSM Visibility (Value Stream Mapping)

Inventory Management

Logistics Management

Materials Sourcing

Negotiation

Production Planning

Purchasing Functions

Reverse Logistics

Tax Rate Optimization

Warehouse Management Functions

***Trend 7 ~ Data Analytics (DA):** The science of examining raw data with the purpose of drawing conclusions about that information. It is used in many industries to allow companies and organization to use historical data to identify quality issues to improve products and make better business decisions, and in the sciences to verify or disprove existing models or theories.*

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## **Necessary Skills and Knowledge**

Algorithms

Artificial Intelligence

Automated Work Instruction Generation

Big Data

Data Mining

Data Observation

Information Technology/Software

Problem Solving

Real Time Asset Management

SQL Programming

Statistical Analysis

Statistical Process Control

**Prediction: Completely new business models will emerge, and shock the older manufacturing dinosaurs.**

***Trend 8 ~ Training & Education: The process of receiving or giving systematic instruction, at a school or university, or on the job.***

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### **Necessary Skills and Knowledge**

Apprentice Program	Job Methods
Augmented reality	Job Relations
Basic Math/Geometry	Job Safety
Communication	Language
Communication/People Skills	Logical, Critical Thinking
Competency Based Learning	Online learning
Cross Function Training	Problem Solving
Degrees vs Skills Qualifications	Process Improvement
Facilitation	Self Motivation/Direction
On-the-job training	Team Working Principles
Instruction of Others	Training Within Industry
Internships	Virtual Reality Simulators
Job Instruction	

***Trend 9 ~ Communication:*** *The purposeful activity of information exchange between two or more participants in order to convey or receive the intended meanings through a shared system of signs and semiotic rules. The basic steps of communication are the forming of communicative intent, message composition, message encoding, transmission of signal, reception of signal, message decoding and finally interpretation of the message by the recipient.*

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## **Necessary Skills and Knowledge**

Applications

Basic Computer Skills

Basic Tablet Skills

Cross Function Training

Customer Support Process

Information Technology/Software

Mobil Technology

Self Directed Teams

Touch Screen

Video

Visual Communication

Presentation Software Skills (i.e. Power Point)

Public Speaking Skills (i.e. Toastmasters)

Teamwork

***Trend 10 ~ Safety:** Protecting the safety, health and welfare of people engaged in work or employment.*

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## **Necessary Skills and Knowledge**

5S

Automation

Basic skills - OSHA 10 type training

Big Data

Compliance

Ergonomics

Industrial Machine Safety

Job Safety

Risk Management

Robotics

Safety Cameras and Sensors

Simulation

Software

Tool Design

**"Manufacturing is a very diverse industry with many areas to specialize. Having the desire to ask questions and never stop learning will make new professionals successful in this line of work."**

**Wayne Funk,  
Manufacturing  
Engineering Manager  
Lockheed Martian**



***Trend 11 ~ Strategic Leadership:*** *The ability to streamline organizations, and engage employees to successfully deal with change by providing a sense of direction, build ownership and alignment within workgroups to implement change.*

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## **Necessary Skills and Knowledge**

Basic Finance skills  
Basic Leadership skills  
Big Data  
Coaching Kata  
Business Modeling  
Coaching  
Communication skills  
Earned Value Management  
Improvement Kata  
Insourcing/Outsourcing  
Operations Management  
Small Crew Management  
Strategic Planning  
Supervisory Skills  
Training Within Industry

***Trend 12 ~ Advanced Materials:*** *The ability to understand and work with the new and smart material which may include ceramics, polymers, semiconductors, magnetic materials, medical implant materials, biological materials and nanomaterials. This relatively new scientific field involves studying materials through the materials paradigm (synthesis, structure, properties and performance).*

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## **Necessary Skills and Knowledge**

Chemistry

Coating

Composite Materials

Environmental Friendly Processes & Materials

Fluid Dynamics

Lubricants

Material Science

Nanotechnology

Physics

Plastics

Recycled/Salvage

Sensors/The Internet of Things (IoT)

Smart Materials

***The cross-correlation of new materials, new technologies, and the new demands of the customer should not be under estimated by manufacturing companies or employees today.***

***Trend 13 ~ Geopolitical Influence:*** *How geography and economics influence politics and the relations between areas, states and nations which can cause positive or negative effects on business.*

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### ***Necessary Skills and Knowledge***

Appreciation of Multi-Cultural Workforce

Culture

Global Sourcing

Global Trade Compliance (Product Classification)

International Law

Negotiation Theory Skills

Political Science

Supply Chain

Understanding Current World Events

**Trend 14 ~ Modeling and Simulation (M&S):** *The process of creating and analyzing a prototype of a physical model to predict its performance in the real world. Simulation modeling uses a digital prototype to help designers and engineers understand whether, under what conditions, and in which ways a part could fail and what loads it can withstand. Simulation modeling can also help predict fluid flow and heat transfer patterns.*

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### ***Necessary Skills and Knowledge***

3D Printing

Augmentation

Artistic

Connected Systems

Experience CAD- SolidWorks/ProE/Catia/NX

Generative Design

Hybrid Manufacturing

Industrial Design

Information Technology/Software Programming

Integrated Value Stream Mapping Visibility

Predicative Simulation

Quantitative Modeling

***Prediction:*** *Manufacturing will never again be concentrated in one area of the globe as there will always be a need for it locally.*

**Trend 15 ~ Performance Effectivity:** *The ability of an employee to deliver the best performance possible and for management to develop methods to encourage best performance out of those under their guidance.*

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### ***Necessary Skills and Knowledge***

Accountability

Business Management Skills

Communication

Math

Proactive Quality

System efficiency vs personal efficiency

Teamwork

Workforce Management

**"Robotics-automation will be a way to improve efficiency and differentiate businesses that use the technology from those that don't."**

**Jorge Medina-Aller  
USA Shade**

**Trend 16 ~ Speed to Market:** *To introduce a product in the market as quickly as possible.*

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### *Necessary Skills and Knowledge*

Agility

Automated Quality Control

Customer Centric

Design for Manufacturability

Design Optimizations

Drones

Flexibility

Manufacturing Scheduling

One Piece Flow versus Batch

Packaging

Plug N Play Assemblies

Product Delivery

Rapid Prototyping (3D Printing)



## Workplace Basic Skills and Attributes for Entry Level Workers

The following skills and attributes for entry level employees were identified by the Texas Workforce Commission. The Manufacturing Future Trends Participants ranked them by their industry need in the workshop follow up survey. Not all Thought Leaders responded to the survey. See pages 22-23 for definition of the skills and attributes.

Skill/Attribute	Responses	N-11
Problem Solving	82%	9
Work Ethic	82%	9
Oral Communication	73%	8
Teamwork	73%	8
Willingness to Continue Learning	73%	8
Pride in Work	64%	7
Integrity	64%	7
Following Directions	45%	5
Attention to Detail	45%	5
Written Communication	36%	4
Appreciation of Diversity	27%	3
Dedication	27%	3
Perseverance	27%	3
Time Management	27%	3
Professionalism	27%	3

Skills/Attributes	Responses	N-11
Numerical and Arithmetic Application	18%	2
Decision-making	18%	2
Customer Service	18%	2
Initiative	18%	2
Technology and Tool Usage	18%	2
Organization	18%	2
Conflict Management	9%	1
Resource Allocation	9%	1
Multi-tasking	9%	1
Stress Management	9%	1
Leadership	0%	0
Intellectual Risk-taking	0%	0
Thoughtful Reflection	0%	0
Creativity	0%	0
Information Gathering	0%	0
Conflict Management	0%	0

**Definitions of Basic Skills and Attributes for Entry Level Workers  
Survey respondent rankings are on page 21)**

<b>Skills and Attributes</b>	<b>Descriptions</b>
Adaptability	Ability to adjust to changing expectations and be flexible when confronted with new or ambiguous circumstances or situations
Appreciation of Diversity	Ability to show empathy and embrace multi-cultural diversity, including viewing new ideas and varying perspectives in a positive fashion
Attention to Detail	Skill in reviewing with a critical eye the fine, detailed aspects of both quantitative and qualitative work process and end products
Conflict Management	Skill in assessing interpersonal situations and resolving or mediating conflict, including taking steps to avoid potential or perceived conflict
Creativity	Ability to conceive of, and contribute, new ideas, alternative pathways, or unique responses to a variety of situations
Critical Thinking	Ability to analyze situations, assess information and judge alternatives in conceptual, intellectual, abstract, mathematical and logical formats
Customer Service	Ability to ascertain, and respond quickly to, the needs of internal and external customers to meet employer expectations and customer satisfaction
Decision-making	Knowledge of how to ask questions, consider options, risks and rewards, set limits and plan goals, and apply information to the process of choosing the best alternative
Dedication	Ability to demonstrate endurance, follow-through and capacity to complete work tasks, including proposing, negotiating and implementing alternative approaches
Following Directions	Ability to follow written and oral instructions, and to adhere to established procedures, business practices and policies, including health and safety
Information Gathering	Ability to observe, to listen to information provided orally and to read material to gather, document and interpret information presented various formats
Initiative	Ability to show self-motivation in getting work done, or done better, in the course of routine, daily work or take the lead in unique situations
Integrity	Ability to be trustworthy and honest, to choose the ethical course of action, and to comply with all applicable rules, laws and regulations
Intellectual Risk-taking	Acceptance of the importance of lifelong education, including learning quickly and thoroughly, and continuously applying new knowledge



## Workplace Basic Skills and Attributes for Baseline Job Preparation Continued

Leadership	Ability to guide, support, mentor, encourage and influence others, passing on knowledge, expertise and training where possible
Multi-tasking	Ability to handle multiple tasks and assignments simultaneously by setting priorities and managing work flow under varying deadlines
Numerical and Arithmetic Application	Skill in compiling data, using numbers in various formats, and performing job-appropriate numbers-based problem-solving
Oral Communication	Skill in expressing ideas and messages to others in a clear, concise and effective manner, including explaining and justifying actions convincingly
Organization	Skill in imposing order and ranking to materials, concepts, and tasks to efficiently manage and balance all types of workplace and personal situations
Perseverance	Ability to continuously improve work, monitor progress, and persist in successfully achieving results and goals regardless of obstacles encountered
Pride in Work	Ability to take personal ownership over the amount and quality of individual performance, team assignments and other duties carried out
Problem-solving	Skill in evaluating systems and operations, identifying the causes of problems, patterns or issues, and in exploring workable solutions or remedies to improve situations
Professionalism	Ability to dress appropriately, speak politely, and conduct ones' self in a manner appropriate for the profession and work site
Resource Allocation	Knowledge of how to identify, leverage and distribute financial and material resources effectively and efficiently
Stress Management	Ability to work under pressure and handle deadlines, including balancing work and family responsibilities
Teamwork	Ability to cooperate, contribute and collaborate as a member of a group in an effort to attain agreement and achieve a collective outcome
Technology and Tool Usage	Knowledge of how to use and apply job-appropriate computer applications and other office equipment, such as copiers and fax machines
Thoughtful Reflection	Skill in logical reasoning, conceptualizing abstract ideas, organizing symbols and graphs, seeing systemic issues, and evaluating data or outcomes
Time Management	Skill in prioritizing tasks, following schedules, and tending to goal-relevant activities in a way that uses time wisely and optimizes efficiency and results
Work Ethic	Consistently demonstrates punctuality, dependability, responsibility and reliability in reporting for duty and carrying out assigned tasks as directed
Written Communication	Skill in effectively conveying written information and messages in a socially acceptable manner that is easily understandable to others

# MANUFACTURING CAREERS

*Note: The following comprehensive list of careers may have inadvertently omitted occupation opportunities. Please confirm before completing career choices.*

*Source of information: U.S. Department of Labor~ Compiled by InterLink*

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Manufacturing includes jobs involved in the fabrication and processing of materials into commercial products. All careers related to the planning, production, producing, and design of end products are included in manufacturing. The manufacturing industry as a whole is slightly different than the manufacturing career group, as manufacturing as a skill set can apply to diverse industries such as agriculture, automotive, and high technology.

The manufacturing industry has become more specialized and technical. Innovations in computer technology, precision manufacturing, micro-assembly, manufacturing processes, robotics and augmented reality, continue to shape the industry. Projected shortages in talent based on current undergraduate enrollment should fuel manufacturing growth and compensation, particularly in manufacturing project management, computer design and, specialized precision production.

- **Adhesive Bonding Machine Operators and Tenders:** Operate or tend bonding machines that use adhesives to join items for further processing or to form a completed product. Processes include joining veneer sheets into plywood; gluing paper; or joining rubber and rubberized fabric parts, plastic, simulated leather, or other materials. Most have a high school diploma or GED
- **Automated Assembly Line Worker:** Works within a system with automation handling strenuous tasks.
- **Aircraft Structure, Surfaces, Rigging, and Systems Assemblers:** Assemble, fit, fasten, and install parts of airplanes, space vehicles, or missiles, such as tails, wings, fuselage, bulkheads, stabilizers, landing gear, rigging and control equipment, or heating and ventilating systems. Most have a high school diploma or GED
- **Biofuels Processing Technicians:** Calculate measure, load, mix, and process refined feedstock with additives in fermentation or reaction process vessels and monitor production process. Perform, and keep records of, plant maintenance, repairs, and safety inspections.
- **Biomass Plant Technicians:** Control and monitor biomass plant activities and perform maintenance as needed.
- **Boilermakers:** Construct, assemble, maintain, and repair stationary steam boilers and boiler house auxiliaries. Align structures or plate sections to assemble boiler frame tanks or vats, following blueprints. Most have a high school diploma or GED
- **Cabinetmakers and Bench Carpenters:** Cut, shape, and assemble wooden articles or set up and operate a variety of woodworking machines, such as power saws, jointers, and mortisers to surface, cut, or shape lumber or to fabricate parts for wood products. Most have some college
- **Chemical Equipment Operators and Tenders:** Operate or tend equipment to control chemical changes or reactions in the processing of industrial or consumer products. Equipment used includes devulcanizers, steam-jacketed kettles, and reactor vessels. Most have a high school diploma or GED
- **Chemical Plant and System Operators:** Control or operate entire chemical processes or system of machines. Most have a high school diploma or GED
- **Cleaning, Washing, and Metal Pickling Equipment Operators and Tenders:** Operate or tend machines to wash or clean products, such as barrels or kegs, glass items, tin plate, food, pulp, coal, plastic, or rubber, to remove impurities. Most have a high school diploma or GED
- **Coating, Painting, and Spraying Machine Setters, Operators, and Tenders:** Set up, operate, or tend machines to coat or paint any of a wide variety of products, including glassware, cloth, ceramics, metal, plastic, paper, or wood, with lacquer, silver, copper, rubber, varnish, glaze, enamel, oil, or rust-proofing materials. Most have a high school diploma or GED

- **Coil Winders, Tapers, and Finishers:** Wind wire coils used in electrical components, such as resistors and transformers, and in electrical equipment and instruments, such as field cores, bobbins, armature cores, electrical motors, generators, and control equipment. Most have a high school diploma or GED
- **Coin, Vending, and Amusement Machine Servicers and Repairers:** Install, service, adjust, or repair coin, vending, or amusement machines including video games, juke boxes, pinball machines, or slot machines. Most have a high school diploma or GED
- **Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic:** Develop programs to control machining or processing of metal or plastic parts by automatic machine tools, equipment, or systems. Most have an associate's or 2-year degree
- **Computer, Automated Teller, and Office Machine Repairers:** Repair, maintain, or install computers, word processing systems, automated teller machines, and electronic office machines, such as duplicating and fax machines. Most have some college
- **Computer-Controlled Machine Tool Operators, Metal and Plastic:** Operate computer-controlled machines or robots to perform one or more machine functions on metal or plastic work pieces. Most have a high school diploma or GED
- **Cooling and Freezing Equipment Operators and Tenders:** Operate or tend equipment, such as cooling and freezing units, refrigerators, batch freezers, and freezing tunnels, to cool or freeze products, food, blood plasma, and chemicals. Most have a high school diploma or GED
- **Crushing, Grinding, and Polishing Machine Setters, Operators, and Tenders:** Set up, operate, or tend machines to crush, grind, or polish materials, such as coal, glass, grain, stone, food, or rubber. Most have a high school diploma or GED
- **Cutters and Trimmers, Hand:** Use hand tools or hand-held power tools to cut and trim a variety of manufactured items, such as carpet, fabric, stone, glass, or rubber. Most have a vocational certificate
- **Cutting and Slicing Machine Setters, Operators, and Tenders:** Set up, operate, or tend machines that cut or slice materials, such as glass, stone, cork, rubber, tobacco, food, paper, or insulating material. Most have a high school diploma or GED
- **Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic:** Set up, operate, or tend machines to saw, cut, shear, slit, punch, crimp, notch, bend, or straighten metal or plastic material. Most have a high school diploma or GED
- **Drilling and Boring Machine Tool Setters, Operators, and Tenders, Metal and Plastic:** Set up, operate, or tend drilling machines to drill, bore, ream, mill, or countersink metal or plastic work pieces. Most have a vocational certificate
- **Electric Motor, Power Tool, and Related Repairers:** Repair, maintain, or install electric motors, wiring, or switches. Most have a high school diploma or GED
- **Electrical and Electronic Equipment Assemblers:** Assemble or modify electrical or electronic equipment, such as computers, test equipment telemetering systems, electric motors, and batteries. Most have a high school diploma or GED
- **Electrical and Electronics Repairers, Commercial and Industrial Equipment:** Repair, test, adjust, or install electronic equipment, such as industrial controls, transmitters, and antennas. Most have an associate's or 2-year degree
- **Electromechanical Equipment Assemblers:** Assemble or modify electromechanical equipment or devices, such as servomechanisms, gyros, dynamometers, magnetic drums, tape drives, brakes, control linkage, actuators, and appliances. Most have a high school diploma or GED
- **Engine and Other Machine Assemblers:** Construct, assemble, or rebuild machines, such as engines, turbines, and similar equipment used in such industries as construction, extraction, textiles, and paper manufacturing. Most have a high school diploma or GED
- **Etchers and Engravers:** Engrave or etch metal, wood, rubber, or other materials. Includes such workers as etcher-circuit processors, pantograph engravers, and silk screen etchers. Most have a high school diploma or GED
- **Extruding and Drawing Machine Setters, Operators, and Tenders, Metal and Plastic:**

Set up, operate, or tend machines to extrude or draw thermoplastic or metal materials into tubes, rods, hoses, wire, bars, or structural shapes. Most have a high school diploma or GED

- **Extruding and Forming Machine Setters, Operators, and Tenders, Synthetic and Glass Fibers:** Set up, operate, or tend machines that extrude and form continuous filaments from synthetic materials, such as liquid polymer, rayon, and fiberglass. Most have a high school diploma or GED
- **Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders:** Set up, operate, or tend machines, such as glass forming machines, plodder machines, and tuber machines, to shape and form products, such as glassware, food, rubber, soap, brick, tile, clay, wax, tobacco, or cosmetics. Most have a high school diploma or GED
- **Fabric and Apparel Patternmakers:** Draw and construct sets of precision master fabric patterns or layouts. May also mark and cut fabrics and apparel. Most have a vocational certificate
- **Fabric Menders, Except Garment:** Repair tears, holes, and other defects in fabrics, such as draperies, linens, parachutes, and tents. Most have a high school diploma or GED
- **Fiberglass Laminators and Fabricators:** Laminate layers of fiberglass on molds to form boat decks and hulls, bodies for golf carts, automobiles, or other products. Most have a high school diploma or GED
- **First-Line Supervisors of Mechanics, Installers, and Repairers:** Directly supervise and coordinate the activities of mechanics, installers, and repairers. Most have a high school diploma or GED
- **First-Line Supervisors of Production and Operating Workers:** Directly supervise and coordinate the activities of production and operating workers, such as inspectors, precision workers, machine setters and operators, assemblers, fabricators, and plant and system operators. Most have a high school diploma or GED
- **Forging Machine Setters, Operators, and Tenders, Metal and Plastic:** Set up, operate, or tend forging machines to taper, shape, or form metal or plastic parts. Most have a high school diploma or GED
- **Foundry Mold and Coremakers:** Make or form wax or sand cores or molds used in the production of metal castings in foundries. Most have a high school diploma or GED
- **Furnace, Kiln, Oven, Drier, and Kettle Operators and Tenders:** Operate or tend heating equipment other than basic metal, plastic, or food processing equipment. Includes activities, such as annealing glass, drying lumber, curing rubber, removing moisture from materials, or boiling soap. Most have a high school diploma or GED
- **Furniture Finishers:** Shape, finish, and refinish damaged, worn, or used furniture or new high-grade furniture to specified color or finish. Most have less than a high school diploma
- **Glass Blowers, Molders, Benders, and Finishers:** Shape molten glass according to patterns. Most have a high school diploma or GED
- **Grinding and Polishing Workers, Hand:** Grind, sand, or polish, using hand tools or hand-held power tools, a variety of metal, wood, stone, clay, plastic, or glass objects. Includes chippers, buffers, and finishers. Most have less than a high school diploma
- **Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic:** Set up, operate, or tend grinding and related tools that remove excess material or burrs from surfaces, sharpen edges or corners, or buff, hone, or polish metal or plastic work pieces. Most have a high school diploma or GED
- **Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic:** Set up, operate, or tend heating equipment, such as heat-treating furnaces, flame-hardening machines, induction machines, soaking pits, or vacuum equipment to temper, harden, anneal, or heat-treat metal or plastic objects. Most have a high school diploma or GED
- **Helpers--Production Workers:** Help production workers by performing duties requiring less skill. Duties include supplying or holding materials or tools, and cleaning work area and equipment. Most have a high school diploma or GED
- **Hydroelectric Plant Technicians:** Monitor and control activities associated with hydropower generation. Operate plant equipment, such as turbines, pumps, valves, gates, fans, electric control boards,

and battery banks. Monitor equipment operation and performance and make necessary adjustments to ensure optimal performance. Perform equipment maintenance and repair as necessary.

- **Industrial Engineer:** A branch of engineering which deals with the optimization of complex processes or systems. Industrial engineers work to eliminate waste of time, money, materials, man-hours, machine time, energy and other resources that do not generate value. According to the Institute of Industrial Engineers, they figure out how to do things better. Most have a Bachelors of Science – Industrial
- **Industrial Engineering Technicians:** Apply engineering theory and principles to problems of industrial layout or manufacturing production, usually under the direction of engineering staff. May perform time and motion studies on worker operations in a variety of industries for purposes such as establishing standard production rates or improving efficiency. Most have an associate's or 2-year degree
- **Industrial Machinery Mechanics:** Repair, install, adjust, or maintain industrial production and processing machinery or refinery and pipeline distribution systems. Most have a vocational certificate
- **Industrial Production Managers:** Plan, direct, or coordinate the work activities and resources necessary for manufacturing products in accordance with cost, quality, and quantity specifications. Most have a bachelor's degree
- **Inspectors, Testers, Sorters, Samplers, and Weighers:** Inspect, test, sort, sample, or weigh nonagricultural raw materials or processed, machined, fabricated, or assembled parts or products for defects, wear, and deviations from specifications. May use precision measuring and complex test equipment. Most have a high school diploma or GED
- **Jewelers:** Fabricate and repair jewelry articles. Make models or molds to create jewelry items. Most have a high school diploma or GED
- **Jewelers and Precious Stone and Metal Workers:** Design, fabricate, adjust, repair, or appraise jewelry, gold, silver, other precious metals, or gems. Includes diamond polishers and gem cutters, and persons who perform precision casting and modeling of molds, casting metal in molds, or setting precious and semi-precious stones for jewelry and related products
- **Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic**  
Set up, operate, or tend lathe and turning machines to turn, bore, thread, form, or face metal or plastic materials, such as wire, rod, or bar stock. Most have a high school diploma or GED
- **Layout Workers, Metal and Plastic:** Lay out reference points and dimensions on metal or plastic stock or workpieces, such as sheets, plates, tubes, structural shapes, castings, or machine parts, for further processing. Includes shipfitters. Most have a high school diploma or GED
- **Machine Feeders and Offbearers:** Feed materials into or remove materials from machines or equipment that is automatic or tended by other workers. Most have a high school diploma or GED
- **Machinists:** Set up and operate a variety of machine tools to produce precision parts and instruments. Includes precision instrument makers who fabricate, modify, or repair mechanical instruments. May also fabricate and modify parts metal in molds, or setting precious and semi-precious stones for jewelry and related products. Most have a high school diploma or GED
- **Maintenance Workers, Machinery:** Lubricate machinery, change parts, or perform other routine machinery maintenance. Most have a high school diploma or GED
- **Manufacturing Production Technicians:** Set up, test, and adjust manufacturing machinery or equipment, using any combination of electrical, electronic, mechanical, hydraulic, pneumatic, or computer technologies. Most have a vocational certificate
- **Mechanical Engineering Technicians:** Apply theory and principles of mechanical engineering to modify, develop, test, or calibrate machinery and equipment under direction of engineering staff or physical scientists. Most have a high school diploma or GED
- **Medical Appliance Technicians:** Construct, fit, maintain, or repair medical supportive devices, such as braces, orthotics and prosthetic devices, joints, arch supports, and other surgical and medical appliances. Most have some college
- **Medical Equipment Repairers:** Test, adjust, or repair biomedical or electromedical equipment. Most have an associate's or 2-year degree

- **Metal-Refining Furnace Operators and Tenders:** Operate or tend furnaces, such as gas, oil, coal, electric-arc or electric induction, open-hearth, or oxygen furnaces, to melt and refine metal before casting or to produce specified types of steel. Most have a high school diploma or GED
- **Methane/Landfill Gas Generation System Technicians:** Monitor, operate, and maintain landfill gas collection system components and environmental monitoring and control systems.
- **Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic:** Set up, operate, or tend milling or planing machines to mill, plane, shape, groove, or profile metal or plastic work pieces. Most have a vocational certificate
- **Millwrights:** Install, dismantle, or move machinery and heavy equipment according to layout plans, blueprints, or other drawings. Most have a high school diploma or GED
- **Mixing and Blending Machine Setters, Operators, and Tenders:** Set up, operate, or tend machines to mix or blend materials, such as chemicals, tobacco, liquids, color pigments, or explosive ingredients. Most have a high school diploma or GED
- **Model Makers, Metal and Plastic:** Set up and operate machines, such as lathes, milling and engraving machines, and jig borers to make working models of metal or plastic objects. Includes template makers. Most have a high school diploma or GED
- **Model Makers, Wood:** Construct full-size and scale wooden precision models of products. Includes wood jig builders and loft workers. Most have a high school diploma or GED
- **Molders, Shapers, and Casters, Except Metal and Plastic:** Mold, shape, form, cast, or carve products such as food products, figurines, tile, pipes, and candles consisting of clay, glass, plaster, concrete, stone, or combinations of materials.
- **Molding and Casting Workers:** Perform a variety of duties such as mixing materials, assembling mold parts, filling molds, and stacking molds to mold and cast a wide range of products. Most have a high school diploma or GED
- **Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic:** Set up, operate, or tend metal or plastic molding, casting, or coremaking machines to mold or cast metal or thermoplastic parts or products. Most have a high school diploma or GED
- **Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic:** Set up, operate, or tend more than one type of cutting or forming machine tool or robot. Most have a high school diploma or GED
- **Musical Instrument Repairers and Tuners:** Repair percussion, stringed, reed, or wind instruments. May specialize in one area, such as piano tuning. Most have a vocational certificate
- **Packaging and Filling Machine Operators and Tenders:** Operate or tend machines to prepare industrial or consumer products for storage or shipment. Includes cannery workers who pack food products. Most have a high school diploma or GED
- **Painters, Transportation Equipment:** Operate or tend painting machines to paint surfaces of transportation equipment, such as automobiles, buses, trucks, trains, boats, and airplanes. Includes painters in auto body repair facilities. Most have a high school diploma or GED
- **Painting, Coating, and Decorating Workers:** Paint, coat, or decorate articles such as furniture, glass, plateware, pottery, jewelry, toys, books, or leather. Most have less than a high school diploma
- **Paper Goods Machine Setters, Operators, and Tenders:** Set up, operate, or tend paper goods machines that perform a variety of functions, such as converting, sawing, corrugating, banding, wrapping, boxing, stitching, forming, or sealing paper or paperboard sheets into products. Most have a high school diploma or GED
- **Patternmakers, Metal and Plastic:** Layout, machine, fit, and assemble castings and parts to metal or plastic foundry patterns, core boxes, or match plates. Most have a vocational certificate
- **Patternmakers, Wood:** Plan, layout, and construct wooden unit or sectional patterns used in forming sand molds for castings. Most have a vocational certificate
- **Photonics Technicians:** Build, install, test, or maintain optical or fiber optic equipment, such as lasers, lenses, or mirrors, using spectrometers, interferometers, or related equipment.

- **Plating and Coating Machine Setters, Operators, and Tenders, Metal and Plastic:** Set up, operate, or tend plating or coating machines to coat metal or plastic products with chromium, zinc, copper, cadmium, nickel, or other metal to protect or decorate surfaces. Includes electrolytic processes. Most have a high school diploma or GED
- **Potters, Manufacturing:** Operate production machines such as pug mill, jigger machine, or potter's wheel to process clay in manufacture of ceramic, pottery and stoneware products. Most have a high school diploma or GED
- **Pourers and Casters, Metal:** Operate hand-controlled mechanisms to pour and regulate the flow of molten metal into molds to produce castings or ingots. Most have a high school diploma or GED
- **Power Distributors and Dispatchers:** Coordinate, regulate, or distribute electricity or steam. Most have an associate's or 2-year degree
- **Precious Metal Workers:** Cast, anneal, solder, hammer, or shape gold, silver, pewter or other metals to form jewelry or other metal items such as goblets or candlesticks. Most have a high school diploma or GED
- **Production, Planning, and Expediting Clerks:** Coordinate and expedite the flow of work and materials within or between departments of an establishment according to production schedule. Duties include reviewing and distributing production, work, and shipment schedules; conferring with department supervisors to determine progress of work and completion dates; and compiling reports on progress of work, inventory levels, costs, and production problems. Most have a high school diploma or GED
- **Purchasing Agents, Except Wholesale, Retail, and Farm Products:** Purchase machinery, equipment, tools, parts, supplies, or services necessary for the operation of an establishment. Purchase raw or semi-finished materials for manufacturing. Most have a bachelor's degree
- **Robotics Technicians:** Build, install, test, or maintain robotic equipment or related automated production systems. Most have an associate's or 2-year degree
- **Rolling Machine Setters, Operators, and Tenders, Metal and Plastic:** Set up, operate, or tend machines to roll steel or plastic forming bends, beads, knurls, rolls, or plate or to flatten, temper, or reduce gauge of material. Most have a high school diploma or GED
- **Semiconductor Processors:** Perform any or all of the following functions in the manufacture of electronic semiconductors: load semiconductor material into furnace; saw formed ingots into segments; load individual segment into crystal growing chamber and monitor controls; locate crystal axis in ingot using x-ray equipment and saw ingots into wafers; and clean, polish, and load wafers into series of special purpose furnaces, chemical baths, and equipment used to form circuitry and change conductive properties. Most have a high school diploma or GED
- **Sewers, Hand:** Sew, join, reinforce, or finish, usually with needle and thread, a variety of manufactured items. Includes weavers and stitchers. Most have less than a high school diploma
- **Sewing Machine Operators:** Operate or tend sewing machines to join, reinforce, decorate, or perform related sewing operations in the manufacture of garment or nongarment products. Most have less than a high school diploma
- **Shoe and Leather Workers and Repairers:** Construct, decorate, or repair leather and leather-like products, such as luggage, shoes, and saddles. Most have a high school diploma or GED  
**Shoe Machine Operators and Tenders:** Operate or tend a variety of machines to join, decorate, reinforce, or finish shoes and shoe parts. Most have a high school diploma or GED
- **Solderers and Brazers:** Braze or solder together components to assemble fabricated metal parts, using soldering iron, torch, or welding machine and flux. Most have a high school diploma or GED
- **Stone Cutters and Carvers, Manufacturing:** Cut or carve stone according to diagrams and patterns. Most have a high school diploma or GED  
**Team Assemblers:** Work as part of a team having responsibility for assembling an entire product or component of a product. Team assemblers can perform all tasks conducted by the team in the assembly process and rotate through all or most of them rather than being assigned to a specific task on a

permanent basis. May participate in making management decisions affecting the work. Includes team leaders who work as part of the team. Most have a high school diploma or GED

- **Textile Bleaching and Dyeing Machine Operators and Tenders:** Operate or tend machines to bleach, shrink, wash, dye, or finish textiles or synthetic or glass fibers. Most have a high school diploma or GED
- **Textile Cutting Machine Setters, Operators, and Tenders:** Set up, operate, or tend machines that cut textiles. Most have a high school diploma or GED
- **Textile Knitting and Weaving Machine Setters, Operators, and Tenders:** Set up, operate, or tend machines that knit, loop, weave, or draw in textiles. Most have a high school diploma or GED
- **Textile Winding, Twisting, and Drawing Out Machine Setters, Operators, and Tenders:** Set up, operate, or tend machines that wind or twist textiles; or draw out and combine sliver, such as wool, hemp, or synthetic fibers. Includes slubber machine and drawing frame operators. Most have a high school diploma or GED
- **Timing Device Assemblers and Adjusters:** Perform precision assembling, adjusting, or calibrating, within narrow tolerances, of timing devices such as digital clocks or timing devices with electrical or electronic components. Most have a high school diploma or GED
- **Tire Builders:** Operate machines to build tires. Most have a high school diploma or GED
- **Tool and Die Makers:** Analyze specifications, lay out metal stock, set up and operate machine tools, and fit and assemble parts to make and repair dies, cutting tools, jigs, fixtures, gauges, and machinists' hand tools. Most have a vocational certificate
- **Tool Grinders, Filers, and Sharpeners:** Perform precision smoothing, sharpening, polishing, or grinding of metal objects. Most have a high school diploma or GED
- **Upholsterers:** Make, repair, or replace upholstery for household furniture or transportation vehicles. Most have a high school diploma or GED
- **Watch Repairers:** Repair, clean, and adjust mechanisms of timing instruments, such as watches and clocks. Includes watchmakers, watch technicians, and mechanical timepiece repairers. Most have a high school diploma or GED
- **Weighers, Measurers, Checkers, and Samplers, Recordkeeping:** Weigh, measure, and check materials, supplies, and equipment for the purpose of keeping relevant records. Duties are primarily clerical by nature. Includes workers who collect and keep record of samples of products or materials. Most have a high school diploma or GED
- **Welders, Cutters, and Welder Fitters:** Use hand-welding or flame-cutting equipment to weld or join metal components or to fill holes, indentations, or seams of fabricated metal products. Many have less than a high school diploma
- **Welders, Cutters, Solderers, and Brazers:** Use hand-welding, flame-cutting, hand soldering, or brazing equipment to weld or join metal components or to fill holes, indentations, or seams of fabricated metal products. Many have less than a high school diploma.
- **Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders:** Set up, operate, or tend welding, soldering, or brazing machines or robots that weld, braze, solder, or heat treat metal products, components, or assemblies. Includes workers who operate laser cutters or laser-beam machines. Many have a high school diploma or GED
- **Woodworking Machine Setters, Operators, and Tenders, Except Sawing:** Set up, operate, or tend woodworking machines, such as drill presses, lathes, shapers, routers, sanders, planers, and wood nailing machines. May operate CNC equipment. Most have a high school diploma or GED



# 2015~2020 InterLink Targeted High Skill/High Demand Occupations

Identified by North Central Texas Regional Employers ~ Organized by Achieve Texas Career Clusters

*Education time is the minimum required for entry to highest expected*

*Wages listed are North Central Texas entry level hourly & regional average hourly for 2014*

*\* Indicates critical regional employer demand but may not meet education or wage criteria*

The absence of an occupation from this list does not necessarily indicate that it will not offer career opportunities

## Agriculture Careers

<u>Career</u>	<u>Education and Wages</u>
Veterinary Technicians/Technologists	2-4 yrs. - \$11.45/14.30

## Architecture & Construction Careers

<u>Career</u>	<u>Education and Wages</u>	<u>Career</u>	<u>Education and Wages</u>
Architects	4 yrs. - \$25.53/34.05	Heating/A.C. Technician	2-5 yrs. - \$15.84/20.78
Carpenters	2-4 yrs. - \$11.06/14.77	Heavy Equipment Operators	OJT - \$13.41/17.20
Computer Aided Design Drafters	2-4 yrs. - \$15.08/18.26	Plumbers/Pipefitters	5 yrs/OJT - \$15.18/20.66
Electricians	2-5 yrs. - \$15.27/20.33	Welders/Cutters/Solderers/Brazers	OJT-2 yrs. - \$12.51/22.68
General Maintenance & Repairers Wkrs	OJT-4 yrs. - \$12.10/17.49		

## Business Management & Administration Careers

<u>Career</u>	<u>Education and Wages</u>	<u>Career</u>	<u>Education and Wages</u>
General and Operations Managers	4-10 yrs. - \$27.67/59.04	Marketing Managers	4 yrs. - \$36.88/57.16
Human Resource Spec.	4 yrs. - \$18.98/32.63		

## Education & Training Careers

<u>Career</u>	<u>Education and Wages</u>	<u>Career</u>	<u>Education and Wages</u>
Teachers, Elementary School	4-10 yrs. - \$24.16/25.04	Teachers, Secondary (High School)	4-10 yrs. - \$25.20/26.30
Teachers, Middle School	4-10 yrs. - \$24.63/27.09		

## Finance Careers

<u>Career</u>	<u>Education and Wages</u>	<u>Career</u>	<u>Education and Wages</u>
Accountants & Auditors	4-10 yrs. - \$21.34/34.07	Financial Analysts	4-10 yrs. \$25.20/33.31
Bookkeeping, Accounting, Auditing Clerks	OJT-4 yrs. - 13.16/18.41		

## Health Science Careers (Also see Emerging & Evolving)

<u>Career</u>	<u>Education and Wages</u>	<u>Career</u>	<u>Education and Wages</u>
*Home Health Aides	OJT. - \$8.65/10.79	Nurses - Registered/BSN	4-10 yrs. - \$26.47/34.05
Medical & Clinical Health Technos.	HS-2 yrs. - \$23.47/30.06	Pharmacy Technicians	OJT - \$12.86/16.56
Medical Assistants	OJT-2 yrs. - \$12.89/19.15	Physical Therapists	5-10 yrs. - \$34.31/43.39
Medical Records/Health Info. Techs.	2-4 yrs. - \$11.69/15.71	Physicians & Surgeons, All Other	10 yrs.+ - \$77.61/90.25
*Nursing Aides & Orderlies (CNA)	OJT - \$10.02/12.29	Physicians Assistants	4-10 yrs. - \$32.70/50.22
Nurses - Licensed Practical/Vocational	2 yrs. - \$17.68/22.95		

## Hospitality & Culinary Careers

<u>Career</u>	<u>Education and Wages</u>	<u>Career</u>	<u>Education and Wages</u>
Chefs and Head Cooks	2-4 yrs. - \$15.72/23.30	Food Service Managers	2-6 yrs. - \$17.63/27.41

## Information Technology Careers (Also see Emerging & Evolving)

<u>Career</u>	<u>Education and Wages</u>	<u>Career</u>	<u>Education and Wages</u>
Computer & Information Systems Mgrs.	4 yrs. - \$42.86/62.41	Computer Network Systems Adm. /	
Computer Programmers	2-4 yrs. - \$24.19/37.07	IT System Adm. /Security	4yrs. - \$26.33/39.75
Computer Network Support Specialists	2-4 yrs. - \$20.23/29.32	Software Developers, Apps.	2-4 yrs. - \$31.85/46.32
Computer Systems Analysts	4 yrs. - \$27.76/39.74	Software Developers, Systems	2-4 yrs. - \$34.34/45.30

## Law, Public Safety, Corrections & Security Careers

<u>Career</u>	<u>Education and Wages</u>	<u>Career</u>	<u>Education and Wages</u>
Fire Fighters	2-4 yrs. - \$18.17/24.77	Police/ Sheriff Patrol Officers	2-4 yrs. - \$22.24/28.48

## Manufacturing Careers

<u>Career</u>	<u>Education and Wages</u>	<u>Career</u>	<u>Education and Wages</u>
Computer Numeric Control(CNC) Operators	OJT-2 yrs. - \$20.08/28.23	Machinists	OJT - \$11.22/17.73

## Marketing Sales & Services Careers

<u>Career</u>	<u>Education and Wages</u>
Marketing Managers	4 yrs. - \$36.88/57.16

## Science, Technology, Engineering & Mathematics (STEM) Careers (Also see Information Technology & Emerging & Evolving)

<u>Career</u>	<u>Education and Wages</u>	<u>Career</u>	<u>Education and Wages</u>
Civil Engineers	4-10 yrs. - \$30.17/42.44	Industrial Engineers	4-10 yrs. - \$29.63/43.84
Electrical/Electronic Engineering Tech.	2-4 yrs. - \$18.01/25.14	Mechanical Engineers	4-10 yrs. - \$29.87/45.72
Electrical Engineers	4-10 yrs. - \$30.62/46.73		

## Transportation, Distribution & Logistics Careers

**Career**

Automotive Body Repairers  
 Automotive Service Technicians  
 Diesel Engine Technicians

**Education and Wages**

2-4 yrs. - \$13.38/19.08  
 2-4 yrs. - \$12.36/16.14  
 2-4 yrs. - \$15.50/19.89

**Career**

Heavy/Tractor-Trailer Truck Drivers  
 Transportation, Distribution  
 Distribution Managers

**Education and Wages**

3-6 mos. - \$12.85/18.11  
 2-4 yrs. - \$20.73/34.17

## 2015 ~ InterLink Emerging and Evolving Careers Projected to Offer Future Employment Opportunities

*Emerging Occupations are new occupations in the workforce with new titles and skills.*

*Evolving Occupations are traditional occupations whose knowledge, skills, and abilities have changed or evolved.*

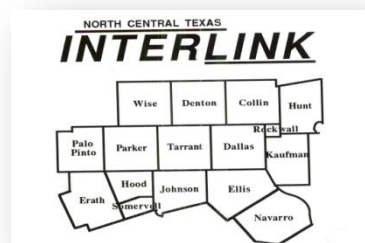
SOC Code/O*NET #EE = Emerging or Evolving Occupation	Occupation Title	Industry
17-2131.00	Advanced Materials/Smart Materials Analysts/Technicians	Science
43-9111.01	Bioinformatics Technicians	Science
17-2031.00	Biomedical Engineers	Science
15-1199.08	Business Intelligence Analysts/Operations Research Analyst	Information Technology
Emerging	Cloud Architects	Information Technology
15-1143	Computer Network Architects/Wireless Network Engineers/Technicians	Information Technology
Evolving	Convergence Technology Spec. /Techs.	Information Technology
Emerging	Data Analysts	Business
17-3025.00	Environmental Engineering Technicians	Engineering
19-4092.00	Forensic Science Technicians (Computer & Digital)	Information Technology
17-3029.10	Fuel Cell Technicians	Energy
45-3021.00/45-3012	Gaming/Computer Simulation Techs. (3-D Artists/Animators/Gaming Techs)	Technology
29-9092	Genetic counselors	Health Science
17-3029.12 /17/3029.11	Nanotechnology Engineering Technicians/Technologists	Technology
15-1122.00	Information Security Analysts Including Cyber Security	Information Technology
29-1171.00	Nurse Practitioners	Health Science
Evolving	Patient Care Technicians (Certified)	Health Science
19-4099.03	Remote Sensing Technicians	Information Technology
13-2099.02	Risk Management Specialists	Business
17-3024.01	Robotics Technicians	Technology
Emerging	Social Media Architects	Business
47-2231	Solar Photovoltaic Technicians (Electric) Installers	Construction

### North Central Texas 16 County Projected Industry Growth 2012-2022

Accommodation & Food Services - 29.2%  
 Administrative & Waste Services - 28.8%  
 Agriculture, Forestry, Fishing, & Hunting - 10.4%  
 Arts, Entertainment, & Recreation - 23.1 %  
 Construction - 26.9%  
 Educational Services, Public & Private - 18%  
 Finance & Insurance - 19.8%

Government - 18.9%  
 Health Care & Social Assistance - 35.6%  
 Management of Companies & Enterprises - 26.6%  
 Manufacturing - 11.7%  
 Mining - 25.9%  
 Other Services, Ex. Government - 22%  
 Professional & Technical Services - 27.5%

Real Estate & Rental & Leasing - 17.7%  
 Retail Trade - 17.4%  
 Transportation & Warehousing - 18.2%  
 Utilities - 16.8%  
 Wholesale Trade - 20.3%  
 Self Employed & Unpaid Family Workers - 18.2%



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# GLOSSARY OF TERMINOLOGY OF NECESSARY MANUFACTURING SKILLS AND KNOWLEDGE

**3 D Printing (Additive Manufacturing, Additive Technology, Augmented Reality, Rapid Prototyping)** - 3D printing is achieved using an additive process, where successive layers of material are laid down in different shapes. A materials printer usually performs 3D printing processes using digital technology and varied materials.

**5S** - A method to evaluate workplace organization capability & visual management by engaging people through the use of 'Standards' and 'Discipline'. 1. Sort: Clearing the work area; 2 Set in Order: Designating locations; 3. Shine: Cleanliness & workplace appearance. 4. Standardize: Everyone doing things the same way. 5. Sustain: Ingraining the 5S's into the culture. The 5S's lead to improved processes and ultimately: Reduced set-up times; Reduced cycle times; Increased floor space; Lower safety incident/accident rate; Less wasted labor and; Better equipment reliability.

**Accountability** - The obligation of an individual or organization to account for its activities, accept responsibility for them, and to disclose the results in a transparent manner. It also includes the responsibility for money or other entrusted property.

**Accounting** - A systematic process of identifying, recording, measuring, classifying, verifying, summarizing, interpreting and communicating financial information. It reveals profit or loss for a given period, and the value and nature of a firm's assets, liabilities and owners' equity.

**Agility** - The ability to think and draw conclusions quickly; intellectual acuity.

**Algorithms** - In mathematics and computer science, an algorithm is a self-contained step-by-step set of operations to be performed. Algorithms exist that perform calculation, data processing, and automated reasoning.

**Application** - Software is developed for low-power handheld devices, such as personal digital assistants, enterprise digital assistants or mobile phones. These applications can be pre-installed on phones during manufacturing, downloaded by customers from various mobile software distribution platforms, or delivered as web applications using server-side or client-side processing (e.g. JavaScript) to provide an "application-like" experience within a Web browser. Application software developers also have to consider a lengthy array of screen sizes, hardware specifications and configurations because of intense competition in mobile software and changes within each of the platforms

**Apprentice Program** - Unskilled workers employed in an industry to learn skills and knowledge according to industry standards while being paid. Lengths vary, but training usually lasts three to five years. Usually apprentices have a starting salary that over a period of time would continue to increase.

**Artificial Intelligence (AI)** - The intelligence of machines or software, and is also a branch of computer science (Applied logic) that studies and develops intelligent machines and software. Major AI researchers and textbooks define the field as "the study and design of intelligent agents" where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success.

**Artistic** - Conforming to the standards of art; satisfying aesthetic requirements: artistic productions are often used in business.

**Augmentation** - Focuses on tasks and environments where human-computer interaction and interfaces exist. Developers, leveraging the tools and findings of neuroscience, aim to develop applications which capture the human user's cognitive state in order to drive real-time computer systems. In doing so, these systems are able to provide operational data specifically targeted for the user in a given context.

**Automated Quality Control** - Most measuring tools today are available with some form of electronic output making it possible to connect the instrument to dataloggers, printers or to a computer, thereby eliminating the steps of manually writing down measurements and typing them in. Automating data collection removes all possibility of human error and it also allows for real time data analysis. In addition to collecting an accurate computerized record, it is also possible to control an entire process based on the input from the tools that used to measure the process. When each part that comes out of the cutting machine is measured, it is fed immediately to a PC that has been programmed to instruct an operator to change the blade when the measurements fall outside a specific tolerance. This type of automation creates an extremely efficient process designed to maintain the manufacturers' quality control standards.

**Automated Work Instruction Generation** - Generative programming is a style of computer programming that uses automated source code creation through generic frames, classes, prototypes, templates, aspects, and code generators to improve programmer productivity. It is often related to code-reuse topics such as component-based software engineering and product family engineering.

**Automation** - The use of machines, control systems and information technologies to optimize productivity in the production of goods and delivery of services. The correct incentive for applying automation is to increase productivity, and/or quality beyond that possible with current human labor levels so as to realize economies of scale, and/or realize predictable quality levels.

**Autonomous Logistics Factory Vehicles** - Autonomous logistics describes systems that provide unmanned, autonomous transfer of equipment, baggage, people, information or resources from point-to-point with minimal intervention.

**Basic Computer Skills** - "Basic computer skills" is a term that is used to identify the essential skills needed in order to make use of a computer. The scope of skills that are considered basic will vary from one situation to another. For example, one employer may consider the ability to make use of a specific type of word processing software to be among the basic skills required, while a different employer will place more emphasis on the ability to work with electronic spreadsheets. Trade schools and some colleges offer courses that introduce students to basic computer skills most commonly required by employers, making it easy to secure the knowledge needed to identify and hone these skills. As a basis for making use of a computer, basic computer skills will often start with understanding how a particular operating system functions in terms of the creation and placement of taskbars on the computer desktop, how to make use of a computer mouse to utilize the programs housed on the hard drive, and even how to go about using an email program to create, send, and receive emails. Tasks such as searching for files on a hard drive are often also considered basic skills that any user should know and be able to perform with relative ease. In some cases, training in how to conduct searches using an Internet browser will also come under the heading of basic operational skills, especially if the job position requires frequent research.

**Basic Finance Skills** - Basic skills in finance begin with knowledge in math and include areas of cash management which includes counting and handling money, bookkeeping, including understanding financial reports, budgets, balance sheets and income statements. Often, basic finance includes finding ways to reduce costs.

**Basic Leadership Skills** - There are characteristics of a good leader and skills of a good leader both of which can be developed and strengthened. Leaders have the ability to get others to do what needs to be done, not because they are told but because they are led to want to do it. Leadership Characteristics may include: exemplary character; enthusiasm about their work or cause; confidence in one self; functions in an orderly and purposeful manner in times of uncertainty; keeps the main goal in focus and thinks analytically; committed to excellence. In any business, exceptional leadership skills are needed in order to succeed. Leadership means understanding that you don't have to come up with ideas yourself – you can also nurture growth and innovation in others that will benefit everyone. The right leadership skills are essential in order to reach your goals and may include: Adaptability - reacting in an effective manner to shifting circumstances in your business environment; People Skills - genuinely connecting with those you work with and who work for you.; Self Awareness - of how they're perceived by others or how they impact the behavior of others are more likely to succeed than those who aren't self aware; Decisiveness - an exercise in good judgment, affording well-informed, fast and sound decisions ; Purposefulness - a vision to set its direction ; Collaborative Skills- working together internally and externally; Innovate and Execute - exchange of innovative ideas to achieve goals.

**Basic Math/Geometry - Proven** understanding of the basics of mathematics which includes comprehension at the levels of addition, subtraction, multiplication, division, algebra and geometry.

**OSHA 10 type training** - OSHA 10 is an outreach and voluntary training program provided by Occupational Safety Health Administration (OSHA), United States Department of Labor. It provides 10 hours of training to the workers and employees touching on appreciation, prevention, avoidance and reduction of safety and health hazards in the workplace. It also enriches the workers knowledge on their rights, employer responsibilities and procedures for complaints and suggestions. OSHA 10 does not meet training requirements for any OSHA standard.

**Basic Tablet Skills** - Tablet usage can include mastering using email, using Skype to video chat, photo editing, setting up your Smartphone, transferring images from your phone to your computer or using Microsoft Word. It can also mean upgrading a machine, creating short movies using your Smartphone, learning basic programming skills, setting up wifi or configuring a small network.

**Basic understanding of computer programming-** BASIC (an acronym for Beginner's All-purpose Symbolic Instruction Code) is a family of general-purpose, high-level programming languages whose design philosophy emphasizes ease of use. In 1964, John G. Kemeny and Thomas E. Kurtz designed the original BASIC language at Dartmouth College in New Hampshire. They wanted to enable students in fields other than science and mathematics to use computers. At the time, nearly all use of computers required writing custom software, which was something only scientists and mathematicians tended to learn. Versions of BASIC became widespread on microcomputers in the mid-1970s and 1980s. Microcomputers usually shipped with BASIC, often in the machine's firmware. Having an easy-to-learn language on these early personal computers allowed small business owners, professionals, hobbyists, and consultants to develop custom software on computers they could afford.

**Battery Technology-** Galvanic cells that store chemical energy. Understanding battery technology includes the understanding of basic battery usage, connections, chemistry and the dangers inherent in battery utilization.

**Big Data - Data Collection-** A collection of data sets so large and complex that it becomes difficult to process using

on-hand database management tools or traditional data processing applications. The challenges include capture, curation, storage, search,

**Brainstorming** - A group creativity technique by which efforts are made to find a conclusion for a specific problem by gathering a list of ideas spontaneously contributed by its members. The term was popularized by Alex Faickney Osborn in the 1953 book *Applied Imagination*.

**Business Management Skills** -The discipline of managing processes (rather than tasks) as the means for improving business performance outcomes and operational agility. Processes span organizational boundaries, linking together people, information flows, systems and other assets to create and deliver value to customers and constituents.

**Business Modeling - Business Process Modeling (BPM)** - In systems engineering is the activity of representing processes of an enterprise, so that the current process may be analyzed and improved. BPM is typically performed by business analysts and managers who are seeking to improve process efficiency and quality. The process improvements identified by BPM may or may not require Health Care involvement, although that is a common driver for the need to model a business process, by creating a process master.

**Chemistry** - A branch of physical science is the study of the composition, properties and behavior of matter. Chemistry is concerned with atoms and their interactions with other atoms, and particularly with the properties of chemical bonds. Chemistry is also concerned with the interactions between atoms (or groups of atoms) and various forms of energy

**Coaching** - Training or development in which a person called a coach supports a learner in achieving a specific personal or professional goal. The learner is sometimes called a coachee.

**Coaching Kata** - Coaching kata is the repeating routine by which lean leaders and managers teach the improvement kata to everyone in the organization. The teacher or coach gives the learner procedural guidance – not solutions – that make the learner successful in overcoming obstacles. (Adapted from Rother, 2010, and Shook, 2008.)

**Coating** - Many types of coatings can be applied in manufacturing plant painting contractors depending on the type of material or surface to be painted. Rubber, silver, plastic, latex or even gold can be used to coat manufacturing components. There are also standard protective coatings like epoxy, latex, phenolic resins, and polyurethane, to mention a few. Coating products are often combined with resins such as alkyd, epoxies, furan, or thermosetting resins to coat components and surfaces with a thin film. For color variations, titanium dioxide-based pigments are also added. Coating fillers like mica, calcium carbonate or talc are also added to maintain coating consistency.

Coatings come in various forms -- aerosols, liquids, powders, solvents-based and many others. Painters often must use protective gear and observe safety methods when applying VOCs-emitting coating products because VOCs such as alcohol, glycol, and other volatile organic substances may be released to the air and harm not only the coating applicator but the environment as well.

**Communication** - The act or process of using words, sounds, signs, or behaviors to express or exchange information or to express your ideas, thoughts, feelings, etc., to someone else and insuring that it is a two way path of understanding.

**People Skills** - Good people skills are an asset in nearly every line of work. In general, good people skills are defined as the ability to listen, to communicate and to relate to others on a personal or professional level. Good people skills also extend to include problem-solving abilities, empathy for others and a willingness to work together toward the common good.

**Competency Based Learning** - or Competency-Based Education and Training is an approach to teaching and learning more often used in learning concrete skills than abstract learning. It differs from other non-related approaches in that the unit of learning is extremely fine grained. Rather than a course or a module every individual skill/learning outcome, known as a competency, is one single unit.

**Compliance** - The act or process of doing what you have been asked or ordered to do : the act or process of complying; the act or process of complying to a desire, demand, proposal, or regimen or to coercion

**Composite Materials** - Also called a composition material or shortened to composite, is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure.

**Computer Numeric Control (CNC)** is the automation of machine tools that are operated by precisely programmed commands encoded on a storage medium, as opposed to controlled manually by hand wheels or levers, or mechanically automated by cams alone. Most CNC today is computer (or computerized) numerical control (CNC) in which computers play an integral part of the control.

**Computer Rendering** - Rendering is the process of generating an image from a model (or models in what collectively could be called a scene file), by means of computer programs.

**Computer savvy** - Advanced skills in the use of computers.

**Computer Technology** - The study of the hardware and software that are the foundations of modern computer

systems which are a fundamental part of everyday lives.

**Computer-aided Design (CAD)** - CAD - Computer-aided design (CAD) is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations.

**Connected Systems/Connectivity** - The quality, state, or capability of being connective or connected; the ability to connect to or communicate with another computer or computer system

**Consumption modeling** - Describes how supply is separated from demand, and that service capacity is created just-in-time. Services are generated from an approved inventory stored in a service catalog (self-service, if you're in IT); with each service having clear pricing. The pricing could be variable and "consumption based" that is, it's not only metered, but based on both true cost as well as opportunity cost for access to the infrastructure. Lastly, the consumption model can also include services brokering - that is, it can include services generated from outside IT as well as those generated within/by IT. Both sources are equally valid, so long as IT still provides common governance, access, pricing and secure delivery to internal LoB customers.

**Coordinate Measuring Machine (CMM) Operation/Programming** - is a device for measuring the physical geometrical characteristics of an object. This machine may be manually controlled by an operator or it may be computer controlled. Measurements are defined by a probe attached to the third moving axis of this machine. Probes may be mechanical, optical, laser, or white light, amongst others. A machine which takes readings in six degrees of freedom and displays these readings in mathematical form is known as a CMM.

**Culture** - That complex whole which includes knowledge, belief, art, morals, law, custom and any other capabilities and habits acquired by man as a member of society or organization.

**Customer Centric** - Identifying the needs of customers by dividing them into segments with common characteristics and determining the appropriate level of attention for them. A firm can classify its customers based on various factors, such as size, buying purpose, nature of products purchased, revenue, potential for growth, geographic location and level of specialization required. A firm can collect the data using surveys and keeping data from all customer interactions, including sales, customer service, complaints, returns and third-party vendors.

**Customer Support Process** - Customer service is the provision of service to customers before, during and after a purchase. According to Turban et al., "Customer service is a series of activities designed to enhance the level of customer satisfaction – that is, the feeling that a product or service has met the customer expectation." The importance of customer service may vary by product or service, industry and customer.

**Data Management** - Comprises all the disciplines related to managing data as a valuable resource.

**Data Mining** – Searching through gigabytes of information for unanticipated information

**Data Observation** - The active acquisition of information from a primary source. In living beings, observation employs the senses. In science, observation can also involve the recording of data via the use of instruments. The term may also refer to any data collected during the scientific activity.

**Design for Manufacturability** - Design for manufacturability (also sometimes known as design for manufacturing or DFM) is the general engineering art of designing products in such a way that they are easy to manufacture. The concept exists in almost all engineering disciplines, but the implementation differs widely depending on the manufacturing technology.

**Design Optimizations** - The utilization of computers to optimize the design of a product. computer-aided design is employed, and it is used for example, to enhance the design of a vehicle so as to minimize the effects of air friction upon it while traveling. Also called automatic design optimization.

**Diagnostic Technology** - Instrumentation process that validates quality of. materials, processes, quality assurance, manufacturing, cost, operation, maintenance, and sustainability.

**Drafting** - The creation, modification, analysis, or optimization of a design.

**Earned Value Management**- (EVM), or Earned value project/performance management (EVPM) is a project management technique for measuring project performance and progress in an objective manner. Earned value management is a project management technique for measuring project performance and progress.

**Engineering drawing/reading** - The ability to draw and interpret a type of technical drawing, which is used to fully and clearly define requirements for engineered items. Engineering drawing (the activity) produces engineering drawings (the documents). More than merely the drawing of pictures, it is also a language—a graphical language that communicates ideas and information from one mind to another.

**Enterprise Resource Planning (ERP)** – A system of programs that relate to how a process takes inputs and turns them into products, by identifying the quantity, types, time frames for purchase, transit and time for the internal process's to make changes to those inputs to forecast replenishment based on perceived and real customer demands.

**Enterprise Resource Planning (ERP) Systems** - An Enterprise Resource Planning (ERP) software system automates

the processes and resources of a company. ERPs are commonly used in manufacturing because of the complex chain of events that must occur after a manufacturer receives an order from a customer. An ERP reduces warehouse and inventory costs, and results in less waste of materials, time and resources. ERPs also give management access to global business intelligence.

**Environmental Friendly Processes & Materials** - The U.S. Environmental Protection Agency (EPA) and state environmental agencies regulate the impact of businesses on the environment. The EPA develops and enforces regulations that implement environmental laws enacted by Congress. Environmental Processes are the method in which manufacturing is performed. Environmental Materials are the different types of materials used in manufacturing which cause no harm to the environment.

**Ergonomics** - An applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely

**Experience CAD- SolidWorks/ProE/Catia/NX** - Software programs used in the Manufacturing Industry.

**Facilitation Skills**- A facilitator is someone who engages in the activity of facilitation. They help a group of people understand their common objectives and assists them to plan how to achieve these objectives; in doing so, the facilitator remains "neutral" meaning he/she does not take a particular position in the discussion.

**Flexibility/Agility** - In a changing marketplace, businesses have to be able to make changes quickly to adapt to client needs and competitor offerings. This means that companies must be able to master both planning for unexpected changes, as well as have business processes in place that allow for changes. The terms “flexibility” and “agility” are frequently used to describe this aspect of supply-change management. While both have similar end goals, there are clear differences between the two in the business world. When referring to flexibility in supply-chain management, managers generally mean scheduling or planning for an unforeseen development. These types of developments are usually unexpected surprises, but businesses can plan for them and make room in their regular business procedures for adaptations, as necessary. When referring to agility in supply-chain management, managers usually mean being able to respond to unplanned for or unscheduled external circumstances. An example of this is an unexpected terrorist attack. No one would be able to predict such an attack, so grocery stores wouldn't order extra supplies in advance. However, the test of the store's agility is seeing how many essential supplies it has in its stockroom, as well as how fast its vendors will deliver more supplies.

**Fluid Dynamics** - The scientific study of the forces acting on liquids and gases and the resulting movements of these fluids.

**Forecasting** - The process of making predictions of the future based on past and present data and analysis of trends. Prediction is a similar, but more general term.

**Generative Design** - Software designs the optimal part based on the parameters governing how the part needs to perform. For instance, programmers specify the loads a new bracket has to withstand during aircraft operation, and then the software can design the bracket, without human input. This can provide a set of design solutions that are inherently different to the shapes created with traditional design methods.

**Global Standardization (ISO-AWS)** - The process of designing things according to a set of agreed international standards. ISO – International Organization for Standardization and AWS – American Welding Standards.

**Global trade compliance (Product Classification)** - The process of classifying products for the purpose of complying with customs authorities, qualifying for free trade agreements and filing entries to customs during the importation or exportation of those products. A slight difference in classification can mean a huge difference in the duties that are paid.

**Green Facilities/Environments** - Are generally healthier, more comfortable, more durable, and more energy efficient and have a much smaller environmental footprint than conventional buildings. Sustainable properties are the future and demand, residential builders, federal government incentives, and local government policy are making driving the initiative for green environments.

**Hybrid Manufacturing** - Additive manufacturing (3D Printing) is not always the best manufacturing process for some designs. Taking a simple example, it is much more efficient and more accurate to create a hole in something with a drill than with additive manufacturing. At the same time, subtractive manufacturing can be incredibly wasteful, with large amounts of the original material being discarded in order to get to the finished shape from a block of an expensive material like titanium. By combining the two processes in a hybrid approach, the manufacturing industry can take advantage of the best of both techniques.

**Imbedded Software Design** - Computer software, written to control machines or devices that are not typically thought of as computers. It is typically specialized for the particular hardware that it runs on and has time and memory constraints.

**Improvement Kata** - The pattern of the improvement kata is a fundamental pattern for improving, adapting and innovating. The improvement kata is scientific, goal-directed working, not random hunting for opportunities or disconnected reaction to problems. Practicing it helps us get better at meeting challenges in business and in many other

endeavors. The improvement kata is the context within which lean tools are intended to be applied. Without it you won't get continuous improvement. In the lean environment, the improvement kata pattern is reinforced in daily management, daily problem solving, quality circles, improvement events & A3s. A version of the improvement-kata pattern is embedded in each of these activities.

**Industrial Automation Security (ISA99)** - Addresses industrial automation and control systems whose compromise could result in endangerment of public or employee safety; loss of public confidence; violation of regulatory requirements; loss of proprietary or confidential information; economic loss, and impact on national security. The concept of manufacturing and control systems electronic security is applied in the broadest possible sense, encompassing all types of plants, facilities, and systems in all industries. Manufacturing and control systems include, but are not limited to hardware and software systems, networked electronic sensing, and monitoring and diagnostic systems and associated internal, human, network, or machine interfaces used to provide control, safety, and manufacturing operations functionality to continuous, batch, discrete, and other processes.

**Industrial Engineering** - A branch of engineering which deals with the optimization of complex processes or systems. Industrial engineers work to eliminate waste of time, money, materials, man-hours, machine time, energy and other resources that do not generate value. According to the Institute of Industrial Engineers, they figure out how to do things better.

**Industrial Machine Safety** - Any machine part, function, or process which may cause injury must be safeguarded. Where the operation of a machine can injure the operator or other workers, the hazard must be controlled or eliminated. Areas to be safeguarded include the point of operation, power transmission apparatus, and other moving parts.

**Information Technology:** Information technology (IT) is the application of computers and telecommunications equipment to store, retrieve, transmit and manipulate data, often in the context of a business or other enterprise. The term is commonly used as a synonym for computers and computer networks, but it also encompasses other information distribution technologies such as television and telephones.

**Information Technology/Software** - Information technology (IT) in manufacturing is the appropriate software for programs used in running manufacturing machines.

**Information Technology/Software Programming** - A programmer, computer programmer, developer, coder, or software engineer is a person who writes computer software. The term computer programmer can refer to a specialist in one area of computer programming or to a generalist who writes code for many kinds of software. One who practices or professes a formal approach to programming may also be known as a programmer analyst.

**Information Worker** - A person employed to produce or analyze ideas and information. May also be called a knowledge worker whose main capital is knowledge in a specialty area in which they are experts.

**Insourcing/Outsourcing:** Insourcing is the commencement of performing a business function that could be contracted out internally: either with the help of a third-party provider who performs the task on-site, or by conducting said task independently. Very often it is seen as opposite of outsourcing. Insourcing is a business decision that is often made to maintain control of critical production or competencies.

**Inspect** - Look at closely, typically to assess their condition or to discover any shortcomings and/or ensure that an official standard is obtained.

**International Standardization Organization (ISO)** – Standardizing by what process the company does things, by describing what they will do and then measuring that they are indeed doing that, thereby providing customers with some measure of understanding that the company follows process's that are repeatable and consistent.

**Outsourcing** - In business, outsourcing involves the contracting out of a business process to another party. Outsourcing sometimes involves transferring employees and assets from one firm to another or from one country or another.

**Instruction of Others** - Giving detailed information telling how something should be done, operated, or assembled.

**Integrated Value Stream** - Integrated Value Stream is a lean-management method for analyzing the current state and designing a future state for the series of events that take a product or service from its beginning through to the customer. It is also known as "material and information flow mapping" and can be applied to nearly any value chain.

**Integrated Value Stream Mapping** – Often referred to as a data rich process map that allows one to easily see the flow of information and material necessary, at the current time to produce product or information. A future value stream map is a projected view of a desired state of the flow of material and or information that would be an improvement over the current state.

**International Law** - A body of rules established by custom or treaty and recognized by nations as binding in their relations with one another.

**Inventory Management** - The overseeing and controlling of the ordering, storage and use of components that a company will use in the production of the items it will sell as well as the overseeing and controlling of quantities of finished products for sale. A business's inventory is one of its major assets and represents an investment that is tied up



until the item is sold or used in the production of an item that is sold. It also costs money to store, track and insure inventory. Inventories that are mismanaged can create significant financial problems for a business, whether the mismanagement results in an inventory glut or an inventory shortage.

**Job Instruction** - Step by step (structured) on the job training method in which a trainer (1) prepares a trainee with an overview of the job, its purpose, and the results desired, (2) demonstrates the task or the skill to the trainee, (3) allows the trainee to demonstrate their ability and knowledge to perform the task and; (4) the trainer provides immediate feedback. In addition this teaches the trainers to live by the words "If the worker hasn't learned, the trainer hasn't trained".

**Job Methods** – A method in which people are trained to observe in finite detail what is currently happening within their process's and how to determine by questioning every detail, what might be improved utilizing what is currently available in people, material, tools, etc.

**Job Production** is used when a product is produced with the labor of one or few workers and is scarcely used for bulk and large scale production. It is mainly used for one-off products or prototypes; Boutique **Manufacturing** is suitable for the production of very small to small batches, i.e. orders of a few units up to several dozens of similar or equal goods. It is often organized with single workplaces or production cells carrying out a number of subsequent production steps until completion of certain components or even the whole product and large assembly lines are generally not used; **Batch Production** is the method used to produce or process any product in groups or batches where the products in the batch go through the whole production process together. It is usually decided upon when productivity of machines is desired or needed. It is the opposite of **One-Piece-Flow**, which is generally the most efficient when all things are considered. To move towards One Piece Flow is one of the stated goals of the Toyota Production System.

**Flow Production** is when the product is built up through many segregated stages; the product is built upon at each stage; **Computer Aided Manufacture and Computer Aided Design** s the use of a wide range of computer-based software tools that assist engineers and architects alike.

**Job Relations** - A simple 4 step method to insure that people problems can be resolved and minimized by retaining sight of the foundations of good relations. It includes building positive employee relations, increasing cooperation and motivation, and effectively resolving conflict.

**Job Safety** – A methodology to teach supervisors that safety of others is a primary function of leadership and that it should entail the understanding that incidents are caused by a chain of events. The goal of supervision is to anticipate that chain of events and find ways to break the chain at any level to stop safety hazards.

**Job Safety Analysis (JSA)** - A procedure which helps integrate accepted safety and health principles and practices into a particular task or job operation. In a JSA, each basic step of the job is to identify potential hazards and to recommend the safest way to do the job. Other terms used to describe this procedure are job hazard analysis (JHA) and job hazard breakdown. Some individuals prefer to expand the analysis into all aspects of the job, not just safety. This approach is known as total job analysis. Methodology is based on the idea that safety is an integral part of every job and not a separate entity.

**Kata:** A kata is a pattern you practice to learn a skill and mindset. Through practice the pattern of a kata becomes second nature - done with little conscious attention - and readily available. The overall goal, as with any kata, is to make the pattern and mindset of the improvement kata an autonomic habit. This happens through deliberate, coached practice in daily work.

**Labor Centric Sourcing** - Defining and quantifying the work it takes to do the job is a fundamental business method of workforce management.

**Ladder Logic Programming** - Ladder logic was originally a written method to document the design and construction of relay racks as used in manufacturing and process control. Each device in the relay rack would be represented by a symbol on the ladder diagram with connections between those devices shown.

**Language** - The method of communication, either spoken or written or computerized, consisting of the use of words in a structured and conventional way.

**Lean Six Sigma** - Lean Six Sigma is a methodology that relies on the scientific method to improve performance, relying on collaborative team effort to improve performance by systematically removing waste; combining lean manufacturing/lean enterprise and Six Sigma to eliminate the eight kinds of waste (muda): Time, Inventory, Motion, Waiting, Over production, Over processing, Defects, and Skills (abbreviated as 'TIMWOODS').

**Logical, Critical Thinking** - Logic - concerned mainly with rules of inference and with methods of reasoning. Logic can be reduced to formal proofs and symbolism. Critical thinking involves putting logic into action in everyday speech and writing. It is not possible to do critical thinking without relying on an understanding of logic. Logic itself does not always involve critical thinking, especially if we are just dealing with formal systems and deductive methods.

**Logistics Management** -Logistics management is the part of supply chain management that plans, implements, and controls the efficient, effective, forward, and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customer's requirements.

**Lubricants** - A substance introduced to reduce friction between surfaces in mutual contact, which ultimately reduces the heat generated when the surfaces move. It may also have the function of transmitting forces, transporting foreign particles, or heating or cooling the surfaces. The property of reducing friction is known as lubricity. A substance introduced to reduce friction between surfaces in mutual contact, which ultimately reduces the heat generated when the surfaces move. It may also have the function of transmitting forces, transporting foreign particles, or heating or cooling the surfaces. The property of reducing friction is known as lubricity.

**Manufacturing Process - Manufacturing process management (MPM)** is a collection of technologies and methods used to define how products are to be manufactured. MPM differs from ERP/MRP which is used to plan the ordering of materials and other resources, set manufacturing schedules, and compile cost data.

**Manufacturing Scheduling** -The process of arranging, controlling and optimizing work and workloads in a production process or manufacturing process. Scheduling is used to allocate plant and machinery resources, plan human resources, plan production processes and purchase materials.

**Material Testing Technicians**- Performs more difficult and responsible sampling and testing of a variety of soils and construction materials in the field or laboratory; has responsibility for explaining and enforcing regulations, policies and legal provisions related to sampling and testing of construction materials; oversees the work testing aides in the field or laboratory; and records log of daily work performed and time and materials expended.

**Materials Science**- Study of the properties of solid materials and how those properties are determined by the material's composition and structure.

**Materials Sourcing** - To link the company's business needs with the capabilities of external suppliers. For this linkage to provide real value supply must be able to interface with two very different worlds—the external world of the marketplace and suppliers and the internal world of business units, projects, and functions. The strategies for effective sourcing simultaneously balance design elements of structure, information, people, goals and measures and external alignments. This required research on extant literature and gleanings from on-ground experience across sourcing professionals.

**Mathematics (Math)** - the science of numbers and their operations, interrelations, combinations, generalizations, and abstractions and of space configurations and their structure, measurement, transformations, and generalizations.

**Measure:** Ascertain the size, amount, or degree of (something) by using an instrument or device marked in standard units or by comparing it with an object of known size.

**Metal Reclamation** - Scrap metal originates both in business and residential environments and consists of left over, re-used, or unused metal materials. Scrap is often taken to a wrecking yard (also known as a scrapyards, junkyard, or breaker's yard), where it is processed for later melting into new products. Scrap prices may vary markedly over time and in different locations. Prices are often negotiated among buyers and sellers directly or indirectly. Prices displayed as the market prices are not the prices that recyclers will see at the scrap yards.

**Micro Electronics** - A subfield of electronics. As the name suggests, microelectronics relates to the study and manufacture (or microfabrication) of very small electronic designs and components. Usually, but not always, this means micrometre-scale or smaller. These devices are typically made from semiconductor materials.

**Micro Machining** - The techniques used in fabricating the miniaturized devices and moving parts into which microelectronic circuitry is integrated

**Mobil Technology** - Technology that is portable; it refers to any device that you can carry with you to perform a wide variety of "tasks". It is technology that allows those tasks to be performed via cellular phone, PDA, vehicles, laptops, etc. A standard mobile device has gone from being no more than a simple two-way pager to being a cellular phone, a GPS navigation system, a web browser, and instant messenger system, a video gaming system, and much more. It includes the use of a variety of transmission media such as: radio wave, microwave, infra-red, GPS and Bluetooth to allow for the transfer of data via voice, text, video, 2-dimensional barcodes and more.

**Mobile Apps** - Software programs that can be downloaded and accessed directly using mobile phone or another mobile device – like a tablet or music player.

**Mobile Service Technicians** - Works in the field of mobile technology and is proficient with the relevant skills and techniques, with a relatively practical understanding of the theoretical principles. Experienced technicians typically have intermediate understanding of theory and expert proficiency in technique. They are generally licensed or certified.

**Multi-Cultural Workforce** - The phrase "multicultural workforce" refers to the changing age, sex, ethnicity, physical ability, race, and sexual orientation of employees across all types and places of work in the United States. Multicultural workforce as a descriptive term or phrase has, however, largely been supplanted by the term "diversity" in describing the increasing heterogeneity of the workplace through the inclusion of different groups of people. While "multicultural workforce" is still sometimes used in reference to employees of varying social, racial, and ability characteristics, the scope of diversity goes further and includes not only the personal characteristics of an organization's employees but also the way an organization responds to a multicultural or diverse workforce .

**Multi-Discipline** - Also called Multidisciplinary combining or involving several academic disciplines or professional specializations in an approach to a topic or problem.

**Nanotechnology** - A branch of engineering that deals with the design and manufacture of extremely small electronic circuits and mechanical devices built at the molecular level of matter.

<http://whatis.techtarget.com/definition/nanotechnology-molecular-manufacturing>

**Negotiation Skills/Negotiation Theory Skills** - A dialogue between two or more people or parties, intended to reach an understanding, resolve point of difference, or gain advantage in outcome of dialogue, to produce an agreement upon courses of action, to bargain for individual or collective advantage, to craft outcomes to satisfy various interests of two people/parties involved in negotiation process.

**One Piece Flow versus Batch** - One Piece Flow refers to the concept of moving one work piece at a time in-between operations. EWAB Flow Technology moves just one piece at a time per pallet. The pallet moves at the speed of Takt time thus minimizing inventory relative to the geographic distance in-between machines. At extremely high speed production and short Takt times, each pallet can also hold more than one piece. Batches Of One refers to the ability to manufacture any size of batch, ultimately down to a batch of one single work piece.

**Online learning** - Online education is a type of distance learning---taking courses without attending a brick-and-mortar school or university. Instead, online students and teachers interact over the Internet. To meet the definition of online education, a course of study should offer two-way communication between teacher and learner and fall under the oversight of an educational institution.

**On-the-job training (OJT)** - A form of training taking place in a normal working situation. On-the-job training, sometimes called direct instruction, is one of the earliest forms of training (observational learning is probably the earliest). It is a one-on-one training located at the job site, where someone who knows how to do a task shows another how to perform it. **Training Within Industry – TWI** – is one methodology that creates a simple systematic way to insure that OJT is accomplished correctly, timely, and with the highest quality.

**Open Source** - Software that comes with permission to use, copy and distribute, either as is or with modifications, and that may be offered either free or with a charge. <http://www.gartner.com/it-glossary/open-source/>

**Operations Management** - The organizing and controlling of the fundamental business activity of providing goods and services to customers.

**OSHA 10** - The OSHA 10 Hour Construction Industry Outreach Training Program is intended to provide an entry level construction worker's general awareness on recognizing and preventing hazards on a construction site. OSHA requires employees throughout the US to complete training by December 1, 2013 to be in compliance with new GHS standards.

**Outsourcing** - In business, outsourcing involves the contracting out of a business process to another party. Outsourcing sometimes involves transferring employees and assets from one firm to another or from one country or another.

**Packaging** - The technology of enclosing or protecting products for distribution, storage, sale, and use. Packaging also refers to the process of designing, evaluating, and producing packages. Packaging can be described as a coordinated system of preparing goods for transport, warehousing, logistics, sale, and end use. Packaging contains, protects, preserves, transports, informs, and sells.

**PDSA/ PDCA** - A scientific method of finding out what works and what doesn't as a continuous circle of events, Plan, Do, Study, Act, and then repeat. Popularized by Dr. Deming. Often referred to as PDCA, Plan, Do Check, Act, but later redefined by Deming for the American (Western) audience as PDSA.

**Person Machine Integration** - Bringing together component subsystems into a whole and ensuring that those subsystems function together, a practice known as system integration. Systems integrators may work in many fields but the term is generally used in the information technology (IT) field, the defense industry, or in media.

**Pervasive Connectivity** - Everyday devices with embedded technology and connectivity as computing devices become progressively smaller and more powerful. Also called ubiquitous computing, pervasive connectivity is the result of computer technology advancing at exponential speeds -- a trend toward all man-made and some natural products having hardware and software. Pervasive computing goes beyond the realm of personal computers: it is the idea that almost any device, from clothing to tools to appliances to cars to homes to the human body to your coffee mug, can be imbedded with chips to connect the device to an infinite network of other devices. The goal of pervasive computing, which combines current network technologies with wireless computing, voice recognition, Internet capability and artificial intelligence, is to create an environment where the connectivity of devices is embedded in such a way that the connectivity is unobtrusive and always available.

**Photovoltaics (PV)** - Is the name of a method of converting solar energy into direct current electricity using semiconducting materials that exhibit the photovoltaic effect, a phenomenon commonly studied in physics, photochemistry and electrochemistry. A photovoltaic system employs solar panels composed of a number of solar cells to supply usable solar power. The process is both physical and chemical in nature, as the first step involves the photoelectric effect from which a second electrochemical process takes place involving crystallized atoms being

ionized in a series, generating an electric current.[1] Power generation from solar PV has long been seen as a clean sustainable energy technology which draws upon the planet's most plentiful and widely distributed renewable energy source – the sun. The direct conversion of sunlight to electricity occurs without any moving parts or environmental emissions during operation.

**Physics** - A science that deals with matter and energy and their interactions.

**Plastics** - Synthetic material made from a wide range of organic polymers such as polyethylene, PVC, nylon, etc., that can be molded into shape while soft and then set into a rigid or slightly elastic form.

**Plug N Play Assemblies** - A plug and play device or computer bus, is one with a specification that facilitates the discovery of a hardware component in a system without the need for physical device configuration or user intervention in resolving resource conflicts.

**Political Science** - Political science is a social science discipline that deals with systems of government and the analysis of political activity and political behavior. It deals extensively with the theory and practice of politics which is commonly thought of as the determining of the distribution of power and resources.

**Power Management & Conservation** - Energy conservation refers to reducing energy consumption through using less of an energy service. Energy conservation differs from efficient energy use, which refers to using less energy for a constant service. For example, driving less is an example of energy conservation. Driving the same amount with a higher mileage vehicle is an example of energy efficiency.

**Predictive Maintenance (PdM)** - Techniques designed to help determine the condition of in-service equipment in order to predict when maintenance should be performed. This approach promises cost savings over routine or time-based preventive maintenance, because tasks are performed only when warranted. The advantage of using this technique provides for having equipment available for use when needed rather than running until failure, when failure can be disastrous both to product and equipment.

**Predictive Simulation/Modeling** – A commonly used statistical technique to predict a statistical model of future behavior. Predictive modeling solutions are a form of data-mining technology that works by analyzing historical and current data and generating a model to help predict future outcomes. In predictive modeling, data is collected, a statistical model is formulated, predictions are made, and the model is validated (or revised) as additional data becomes available. <http://www.gartner.com/it-glossary/predictive-modeling/>

**Proactive Quality**-Acting before a situation becomes a source of confrontation or crisis. In proactive development you solve matters before they become an issue. You generally spend more times on the optimizations (for example, improved security or caching of everything). Proactive development makes developments more stable. There are some things that should always be done in a proactive mode, for example, backups, privacy concerns and basic security issues.

**Problem Solving** – A preferred method to determine root cause issues, rather than making assumptions and spending a tremendous amount of time and energy on firefighting problems that usually only delays the reoccurrence of the same problem rather than eliminating the root cause. It consists of using generic or ad hoc methods, in an orderly manner, for finding solutions to problems.

**Process improvement** - Process improvement is an aspect of organizational development (OD) in which a series of actions are taken by a process owner to identify, analyze and improve existing business processes within an organization to meet new goals and objectives, such as increasing profits and performance, reducing costs and accelerating schedules. These actions often follow a specific methodology or strategy to encourage and ultimately create successful results. Process improvement may include the restructuring of company training programs to increase their effectiveness. Process improvement is also a method to introduce process changes to improve the quality of a product or service, to better match customer and consumer needs.

**Product Delivery** - The process of transporting goods from a source location to a predefined destination. There are different delivery types. Cargo (physical goods) are primarily delivered via roads and railroads on land, shipping lanes on the sea and airline networks in the air. Certain specialized goods may be delivered via other networks, such as pipelines for liquid goods, power grids for electrical power and computer networks such as the Internet or broadcast networks for electronic information. The general process of delivering goods is known as distribution. The study of effective processes for delivery and disposition of goods and personnel is called logistics. Firms that specialize in delivering commercial goods from point of production or storage to point of sale are generally known as distributors, while those that specialize in the delivery of goods to the consumer are known as delivery services.

**Product Planning** - The ongoing process of identifying and articulating market requirements that define a product's feature set. Product planning serves as the basis for decisions about price, distribution and promotion. It is the process of creating a product idea and following through on it until the product is introduced to the market.

**Production Line Simulation** - Manufacturing represents one of the most important applications of Simulation. This technique represents a valuable tool used by engineers when evaluating the effect of capital investment in equipments

and physical facilities like factory plants, warehouses, and distribution centers. Simulation can be used to predict the performance of an existing or planned system and to compare alternative solutions for a particular design problem.[

**Production Planning** - The planning of production and manufacturing modules in a company or industry. It utilizes the resource allocation of activities of employees, materials and production capacity, in order to serve different customers. Different types of production methods, such as single item manufacturing, batch production, mass production, continuous production etc. have their own type of production planning. Production planning can be combined with production control into production planning and control, or it can be combined and or integrated into enterprise resource planning.

**Project management** - The application of knowledge, skills, tools and techniques to project activities to meet the project requirements.

**Public Speaking Skills (i.e. Toastmasters)** - The skill, practice, or process of making speeches to large groups of people. Toastmasters is an organization whose members learn and practice speaking in front of groups.

**Purchasing Functions** - Purchasing refers to a business or organization attempting to acquiring goods or services to accomplish the goals of its enterprise. Though there are several organizations that attempt to set standards in the purchasing process, processes can vary greatly between organizations. Typically the word "purchasing" is not used interchangeably with the word "procurement", since procurement typically includes Expediting, Supplier Quality, and Traffic and Logistics (T&L) in addition to Purchasing.

**Quality Control**- A system of maintaining standards in manufactured products by testing a sample of the output against the specification. It also involves determining what other methods might be deployed to improve product to more consistently meet the required standards and may often result in using other means than testing or inspecting.

**Quantitative Modeling** - Collection of mathematical and statistical methods used in the solution of managerial and decision-making problems, also called operations research (OR) and management science.

**Radio Frequency Information Device (RFID)** - An automated data collection technology that uses radio frequency waves to transfer data between a reader and a tag to identify, track and locate the tagged item where the tag maintains information electronically that is obtained via the interrogation techniques of radio waves to transfer and then interpret that information.

**Real Time Asset Management** - Relating to a system in which input data is processed within milliseconds so that it is available virtually immediately as feedback,

**Reactive Quality** - Reacting to the past rather than anticipating the future. In reactive development you solve matters as they arise. This can spark creativity and you can focus on the progress rather than optimizing for millions of users or security threats that aren't there. Other things, such as exploring new and unproven features, can be done in a reactive mode.

**Recycle** - Recycling is a process to convert waste materials into reusable material to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from landfilling) by reducing the need for "conventional" waste disposal and lower greenhouse gas emissions as compared to plastic production.

**Recycled/Salvage** - Scrap metal originates both in business and residential environments and consists of left over, re-used, or unused metal materials. Scrap is often taken to a wrecking yard (also known as a scrapyards, junkyard, or breaker's yard), where it is processed for later melting into new products. Scrap prices may vary markedly over time and in different locations. Prices are often negotiated among buyers and sellers directly or indirectly. Prices displayed as the market prices are not the prices that recyclers will see at the scrap yards.

**Repeatability** - Or test-retest reliability is the variation in measurements taken by a single person or instrument on the same item, under the same conditions, and in a short period of time. A less-than-perfect test-retest reliability causes test-retest variability. Such variability can be caused by, for example, intra-individual variability and intra-observer variability.

**Resource Scarcity Management** - Deals with the supply, demand, and allocation of the Earth's natural resources. One main objective of natural resource economics is to better understand the role of natural resources in the economy in order to develop more sustainable methods of managing those resources to ensure their availability to future generations. Resource economists study interactions between economic and natural systems, with the goal of developing a sustainable and efficient economy.

**Reverse Logistics** - Reverse logistics is for all operations related to the reuse of products and materials. It is "the process of moving goods from their typical final destination for the purpose of capturing value, or proper disposal. Remanufacturing and refurbishing activities also may be included in the definition of reverse logistics."

**Risk analysis** -The process of defining and analyzing the dangers to individuals, businesses and government agencies posed by potential natural and human-caused adverse events.

<http://searchmidmarketsecurity.techtarget.com/definition/risk-analysis>

**Risk mitigation** - The plan(s) for what to do about the risks identified by Risk Analysis.

**Robotic Operations /Set Up/Maintenance-** The use of robots in industry continues to grow and companies that integrate robots into their workflow become more efficient and more competitive. Construction robots are often used in the industry for fabrication. A few robots exist on the construction job site, but the majority of robots used in fabrication in the construction industry are not on the job site. Instead, they are used in building construction machinery, arc welding metal components, applying adhesives, and assembling doors and windows. Construction robots are also used in the handling and manipulation of bricks and other heavy blocks. Brick and concrete block laying can be challenging both physically and mentally when performed through human labor. While not many robots have been utilized on the job yet, trials have shown how robot use in this field could prove beneficial. Robotic systems can also be utilized to dispense concrete on the job site. Instead of human labor applying the concrete, a robot can layer concrete vertically to form a structure. This process is similar to the application of adhesive process, except that concrete is much heavier than typical adhesives.

**Robotics** - The branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, and/or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics. Source: InterLink Future Trends in Information Technology Report, [www.interlink-ntx.org](http://www.interlink-ntx.org)

**Robotics Applications** - Robotics is the branch of mechanical engineering, electrical engineering and computer science that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, and/or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics.

**Root Cause Analysis** - Root cause analysis (RCA) is a method of problem solving used for identifying the root causes of faults or problems. A factor is considered a root cause if removal thereof from the problem-fault-sequence prevents the final undesirable event from recurring; whereas a causal factor is one that affects an event's outcome, but is not a root cause.

**Safety** - The condition of being protected from or unlikely to cause danger, risk, or injury.

**Safety Data Sheets** - An important component of product stewardship and occupational safety and health. It is intended to provide workers and emergency personnel with procedures for handling or working with that substance in a safe manner, and includes information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures. MSDS formats can vary from source to source within a country depending on national requirements.

**Time Management** - the act or process of planning and exercising conscious control over the amount of time spent on specific activities, especially to increase effectiveness, efficiency or productivity. Source: Wikipedia

**Scientific Method** - The scientific method is a body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge. To be termed scientific, a method of inquiry must be based on empirical and measurable evidence subject to specific principles of reasoning.

**Self Directed Teams** - A self-directed work team (SDWT) is a group of people, usually employees in a company, who combine different skills and talents to work without the usual managerial supervision toward a common purpose or goal.

**Self Motivation/Direction** - Self-direction is being the driver of your own life, your goals and how you reach them. A motive is what prompts the person to act in a certain way, or at least develop an inclination for specific behavior.

**Sensors and Safety cameras-** A device that takes input from the physical environment and uses built-in compute resources to perform predefined functions upon detection of specific input and then process data before passing it on. Smart sensors enable more accurate and automated collection of environmental data with less erroneous noise amongst the accurately recorded information. These devices are used for monitoring and control mechanisms in a wide variety of environments including smart grids, battlefield reconnaissance, exploration and a great number of science applications. The smart sensor is also a crucial and integral element in the Internet of Things (IoT), the increasingly prevalent environment in which almost anything imaginable can be outfitted with a unique identifier (UID) and the ability to transmit data over the Internet or a similar network.

**Simulation Analysis** - A problem solving technique used to approximate the probability of certain outcomes by running multiple trial runs, called simulations, using random variables. The use of numerical methods to simulate the behavior of engineered systems during operations and accidents brings major benefits in understanding, which is essential to decision makers. It includes Complex situations involving statics, dynamics, non-linearity, laminar flows, turbulence, thermal effects, shocks and impacts. Source: National Infrastructure Simulation and Analysis Center (NISAC)

**Simulation Technology** - The process of using modern computer software and hardware to analyze the potential outcome of a given situation, based on known factors and the introduction of one or more variables that have the ability to influence the outcome of any given situation. This type of computer modeling is helpful in many different situations. The idea behind the creation of the simulation is to minimize the possibility of an undesirable outcome from emerging, while also uncovering factors that are likely to enhance the chances for success. Source: WiseGeek.com

**Simulations** - The use of a mathematical or computer representation of a physical system for the purpose of studying constraint effects. <http://www.gartner.com/it-glossary/simulation/>

**Six Sigma/Lean** - Seeks to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing variability in manufacturing and business processes.

**Small Crew Management** - Crew resource management (CRM) training, teaches small teams or crews how to improve communication, prioritize tasks, delegate authority, and monitor automated equipment.

**Smart Materials** - Designed materials that have one or more properties that can be significantly changed in a controlled fashion by external stimuli, such as stress, temperature, moisture, pH, electric or magnetic fields.

**Smart Sensor Cameras** - A smart sensor camera or intelligent sensor camera is a vision system which, in addition to image capture circuitry, is capable of extracting application-specific information from the captured images, along with generating event descriptions or making decisions that are used in an intelligent and automated system.

**Social Networking** - The practice of expanding the number of one's business and/or social contacts by making connections through individuals. <http://whatis.techtarget.com/definition/social-networking>

**Social networks** - Social networking sites, such as LinkedIn, Facebook or MySpace, provide open membership where people can congregate to share information. They are an example of a decentralized network that exhibits emergent behavior.

**Soft Skills** - A term often associated with a person's "EQ" (Emotional Intelligence Quotient), the cluster of personality traits, social graces, communication, language, personal habits, interpersonal skills, managing people, leadership, etc. that characterize relationships with other people.

**Software** - A general term for the various kinds of programs used to operate computers, machines, and related devices.

**Software and hardware Integration** - The computer system integration of application and process.

**Spreadsheet Proficiency (i.e. Excel)** - A spreadsheet is an interactive computer application for organization, analysis and storage of data in tabular form. Spreadsheets are developed as computerized simulations of paper accounting worksheets. The program operates on data represented as cells of an array, organized in rows and columns. Each cell of the array may contain either numeric or text data, or the results of formulas that automatically calculate and display a value based on the contents of other cells.

**SQL Programming** - SQL is a special-purpose programming language designed for managing data held in a relational database management system, or for stream processing in a relational data stream management system.

**Statistical Analysis** - Statistical analysis is a component of data analytics. In the context of business intelligence (BI), statistical analysis involves collecting and scrutinizing every single data sample in a set of items from which samples can be drawn. Statistical analysis can be broken down into five discrete steps, as follows: Describe the nature of the data to be analyzed; Explore the relation of the data to the underlying population; Create a model to summarize understanding of how the data relates to the underlying population; Prove (or disprove) the validity of the model; Run un scenarios that will help guide future actions. The goal of statistical analysis is to identify trends.

**Statistical Process Control** - Statistical process control (SPC) is a method of quality control which uses statistical methods. SPC is applied in order to monitor and control a process. Monitoring and controlling the process ensures that it operates at its full potential. At its full potential, the process can make as much conforming product as possible with a minimum (if not an elimination) of waste (rework or scrap).

**Statistician** - Use statistical methods to collect and analyze data and help solve real-world problems in business, engineering, the sciences, or other fields.

**Statistics** - A branch of mathematics dealing with the collection, analysis, interpretation, and presentation of masses of numerical data

**Strategic planning** - Is an organization's process of defining its strategy, or direction, and making decisions on allocating its resources to pursue this strategy.

**Supervisory Skills** - A supervisor's job is to establish goals and lead a team of people to achieve them. Leadership requires stepping out in front with new, creative ideas that save money, increase productivity and establish credibility and respect from employees.

**Supply chain** - The network of all the individuals, organizations, resources, activities and technology involved in the creation and sale of a product, from the delivery of source materials from the supplier to the manufacturer, through to its eventual delivery to the end user.

**Supply Chain Management** - Supply chain management (SCM) is the management of the flow of goods. It includes

the movement and storage of raw materials, work-in-process inventory, and finished goods from point of origin to point of consumption.

**Supply Chain Management (distribution)** - A holistic perspective of supply chain processes and technologies that go beyond the focus of delivery, inventory and traditional views of cost.

<http://searchmanufacturingerp.techtarget.com/definition/supply-chain-sustainability>

**Supply Chain Value Stream Mapping** - Specific activities within a supply chain required to design order and provide a specific product or service.

**Surveillance** - A digitized and networked version of closed-circuit television (CCTV).

<http://whatis.techtarget.com/definition/IP-surveillance>

**System efficiency vs personal efficiency** - Efficiency is primarily concerned with cost minimization concepts, effectiveness is concerned with the achievement of organizational goals. Management information systems--which gather data and organize them into meaningful, timely flows of information for the decision-making process--must consider the characteristics of amount, form, and flow of information, as well as the effectiveness and efficiency criteria of successful decisions.

**Systems Thinking/Development & Integration** - System Development – Insuring that the system to be developed will fit correctly in the customer’s infrastructure, that the technology used is consonant to that used by the organization, and that maintenance will not represent a burden to the operation. Systems Integration –Systems can no longer perform independently, the information infrastructure of any given organization will be most valuable when it acts as one, as though one set of information traverses from domain to domain (system to system) seamlessly, reducing the end-user’s effort on maintaining “multiple systems.”

**Systems Thinking/Technology** - Can refer to material objects of use to humanity, such as machines, hardware or utensils, but can also encompass broader themes, including systems, methods of organization, and techniques. The term can either be applied generally or to specific areas: examples include "construction technology", "medical technology", or "state-of-the-art technology".

**Tax Rate Optimization** - Finding outside sources of capital can be a challenge for private companies. That’s why saving tax is often the first line of defense for owners of private companies. Tax optimization can lead to an additional source of cash. The lower a private company’s overall tax rate, the more cash is left at the end of each year for the owner to reinvest in the company, or to consider as profit.

**Team Work Principals/Building** - A philosophy of job design in which employees are viewed as members of interdependent teams instead of as individual workers. It is said to have benefits of self-development, positive communication, leadership skills and the ability to work closely together as a team to solve problems.

**Teamwork** - A joint action by a group of people, in which each person subordinates his or her individual interests and opinions to the unity and efficiency of the group. This does not mean that the individual is no longer important; however, it does mean that effective and efficient teamwork goes beyond individual accomplishments. The most effective teamwork is produced when all the individuals involved harmonize their contributions and work towards a common goal.

**Technology Skills** - Use technology-related terms, concepts, data input strategies and ethical practices to make informed decisions about current technologies and their applications.

**The Internet of Things** - A global network infrastructure includes existing and evolving Internet and network developments. It will offer specific object-identification, sensor and connection capability as the basis for the development of independent

**Time Management** - the act or process of planning and exercising conscious control over the amount of time spent on specific activities, especially to increase effectiveness, efficiency or productivity. Source: Wikipedia

**Tool Design** - Design tools are objects, media, or computer programs, which can be used to design. They may influence the process of production, expression and perception of design ideas[1] and therefore need to be applied skillfully.[

**Tools and equipment** - Any tool is any physical item that can be used to achieve a goal, especially if the item is not consumed in the process. Informally the word is also used to describe a procedure or process with a specific purpose. Tools that are used in particular fields or activities may have different designations such as "instrument", "utensil", "implement", "machine", or "apparatus". The set of tools needed to achieve a goal is "equipment". The knowledge of constructing, obtaining and using tools is technology.

**Touch Screen** - An input device normally layered on the top of an electronic visual display of an information processing system. A user can give input or control the information processing system through simple or multi-touch gestures by touching the screen with a special stylus/pen and-or one or more fingers. Some touchscreens use ordinary or specially coated gloves to work while others use a special stylus/pen only. The user can use the touchscreen to react to what is displayed and to control how it is displayed; for example, zooming to increase the text size.



**Training Within Industry (TWI)** - Originally a 1940's government program that immensely aided the War effort by helping train Supervisors, while on the job. Many credited that program for the increase in productivity that stunned the world. While shortly after WWII it fell out of favor in industry for being too simple it took off in many other parts of the world, specifically Japan amongst others. Since 2000 it has begun a well-deserved resurgence within all sorts of companies in the US and world, by providing straightforward methods for Supervisors and others to improve; Job Relations, Job Instructions, Job Methods and Job Safety.

**Understanding Current World Events** - Awareness of events occurring in the world and the implications that may affect one's business or personal life.

**Units Conversions** - The conversion between different units of measurement for the same quantity, typically through multiplicative conversion factors. The process of conversion depends on the specific situation and the intended purpose. This may be governed by regulation, contract, technical specifications or other published standards.

**Video** - An electronic medium for the recording, copying, playback, broadcasting, and display of moving visual media. Video systems vary greatly in the resolution of the display, how they are refreshed, and the rate of refresh, and 3D video systems exist. They can also be carried on a variety of media, including radio broadcast, tapes, DVDs, computer files etc.

**Virtual reality (VR) Simulators** - Provides a computer-generated 3D environment that surrounds a user and responds to that individual's actions in a natural way, usually through immersive head-mounted displays and head tracking. Gloves providing hand tracking and haptic (touch sensitive) feedback may be used as well. Room-based systems provide a 3D experience for multiple participants; however, they are more limited in their interaction capabilities.

**Virtualization** - The creation of a virtual (rather than actual) version of something, such as an operating system, a server, a storage device or network resources.

**Visual Communication** - Communication through a visual aid and is described as the conveyance of ideas and information in forms that can be read or looked upon.

**Warehouse Management Functions** - Or, warehouse management system (WMS) provides a suite of features and services that address a comprehensive set of warehouse operations. Although each WMS might provide different secondary level services, the primary features of a WMS are centered on inventory management. A typical WMS may provide features such as inventory record management, inventory shipment details, stock location within the warehouse and overall warehouse capacity management. WMS is generally a part of an enterprise resource planning (ERP) software solution, but it can also be a standalone application. Moreover, a WMS is generally directly integrated with other information systems such as supply chain management system, production/manufacturing information system and sales information systems.

**Waste reduction** - Waste reduction (or prevention) is the preferred approach to waste management because waste that never gets created doesn't have waste management costs. An example of waste reduction is reducing unnecessary packaging from manufactured products and produce.

**Water Conservation** - Encompasses the policies, strategies and activities to manage fresh water as a sustainable resource, to protect the water environment, and to meet current and future human demand. Population, household size and growth and affluence all affect how much water is used. Factors such as climate change will increase pressures on natural water resources especially in manufacturing and agricultural irrigation. Source: Wikipedia

**Water Treatment** - Collectively, the industrial-scale processes that makes water more acceptable for an end-use, which may be drinking, industry, or medicine. Water treatment is unlike portable water purification that campers and other people in wilderness areas practice.

**Welding** - A fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing fusion, which is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal.

**Wind Power Generation** - The conversion of wind energy into a useful form of energy, such as using wind turbines to produce electrical power, windmills for mechanical power, windpumps for water pumping or drainage, Large wind farms consist of hundreds of individual wind turbines which are connected to the electric power transmission network.

**Workflow** - consists of an orchestrated and repeatable pattern of business activity enabled by the systematic organization of resources into processes that transform materials, provide services, or process information. It can be depicted as a sequence of operations, declared as work of a person or group, an organization of staff, or one or more simple or complex mechanisms.

**Workforce Management** - After employees have been hired, the "workforce" needs to be managed so that they know what to work on. Typical areas of focus include scheduling employees work hours, planning work responsibilities and duties, working as a team, and tracking results of the work efforts. Also called employee relationship management.

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***INTERLINK*** Est. 1987

**P.O. Box 610246  
DFW Airport, Texas 75261-0246  
Phone: 214.797.5056  
Email: [candy@interlink-ntx.org](mailto:candy@interlink-ntx.org)  
Website: [www.interlink-ntx.org](http://www.interlink-ntx.org)**

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**University of Texas at Arlington  
202 E. Border Street, Suite #323  
Arlington, TX 76010  
Phone: 817.307.0613  
Email: [pboutier@uta.edu](mailto:pboutier@uta.edu) & [pat.boutier@tmac.org](mailto:pat.boutier@tmac.org)  
Websites: [www.tmac.org](http://www.tmac.org) & [www.tmacdfw.org](http://www.tmacdfw.org)**

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