




## Anticipation Guide: Advanced Manufacturing

Read each of the following statements. Then decide how strongly you agree or disagree with each.

After learning about manufacturing, look back at your ratings. Discuss how your thinking has changed or been confirmed on one or more of the statements.

Statement	Before		After	
	Agree	Disagree	Agree	Disagree
Everything you touch has been manufactured.				
Manufacturing requires high- tech solutions and a highly skilled and qualified work force.				
The manufacturing marketplace consists only of human-run assembly lines.				
Manufacturers work in dark factories.				
When I think of manufacturing it looks like this: 				
Manufacturers work with robots to build products together.				
I would be interested in pursuing a career in advanced manufacturing.				



## Advanced Manufacturing Careers Build the Future

The world of high-tech manufacturing is exploding with exciting opportunities for today's students. In fact, since 2010, the manufacturing industry has added almost 600,000 jobs! As jobs in advanced manufacturing gain momentum, manufacturers are looking for highly skilled production workers and engineers.

This virtual job fair has been designed to help you explore different career pathways that can help you learn about and prepare for a variety of exciting and challenging jobs in advanced manufacturing.

Hearing the word "manufacturing" at one time might have made you think about dark factories crammed with people assembling products; it should now bring to mind images of innovation and collaboration of people working to build the future. Manufacturing is now being shaped by advances in 3-D printing, human-robot interactions, and extreme customization.

So, what is advanced manufacturing? Advanced manufacturing is the use of innovative technology to improve products or processes. Advanced manufacturing improves existing or creates entirely new materials, products, and processes via the use of science, engineering, and information technologies; high-precision tools and methods; a high-performance workforce; and innovative business or organizational models.

According to the President's Council of Advisors on Science and Technology Report to the President on Ensuring American Leadership in Advanced Manufacturing: Advanced Manufacturing is "a family of activities that (a) depend on the use and coordination of information, automation, computation, software, sensing, and networking, and/or (b) make use of cutting edge materials and emerging capabilities enabled by the physical and biological sciences, for example nanotechnology, chemistry, and biology. This involves both new ways to manufacture existing products, and especially the manufacture of new products emerging from new advanced technologies."

The average salary of advanced manufacturing workers make more than \$77,000 and have the highest job tenure in the private sector. This field includes chemical manufacturing engineers who are currently the highest paid new college graduates.

President Obama has launched a partnership with industry and university leaders to identify and invest in new technologies that will make U.S. manufacturers more competitive. Modern manufacturing facilities are already producing advances in robotics, automation, and 3D printing which have opened up exciting new careers. Advanced manufacturing uses these technologies to improve products and processes.



Economic growth depends on manufacturing growth. By 2030, 77% of skilled baby boomers will have left the workforce. The future of U.S. Manufacturing relies on a skilled, talented workforce and educating our students about the diverse opportunities available to them in advanced manufacturing careers.

Are you ready to build the future?

### Can you see yourself in Advanced Manufacturing?

John Holland's Strong Interest Survey is a tool that guides students toward careers that match their interests. It is based on the theory that career choice is an expression of personality. Your interests suggest a lot about who you are, as well as career fields, activities, and majors you might enjoy.

Review the six personality types below, and rank them from 1-6, with 6 matching the profile that sounds the most like you and 1 matching the profile that sounds the least like you. Then, use the links to explore more about the advanced manufacturing careers that align with each personality type.

Personality Type	Rating	Advanced Manufacturing Careers
<b>Realistic:</b> A realistic person prefers concrete tasks. He or she likes working alone or with other realistic people. This person might be interested in mechanical creativity and physical dexterity and enjoy working with machines, tools, and being outdoors.		<a href="#">chemical engineers</a> , <a href="#">electrical engineers</a> , <a href="#">industrial engineers</a> , <a href="#">computer engineers</a> , <a href="#">mechanical engineers</a> , <a href="#">environmental engineers</a> , <a href="#">aerospace engineers</a> , and <a href="#">mechanics</a>
<b>Investigative:</b> Someone who is investigative likes to use his or her abstract or analytical skills to figure things out. He or she is a "thinker" who strives to complete tasks and often prefers to do so independently. This person might be interested in doing lab work, analyzing data, researching and investigation and would enjoy working with science, ideas, theories, and data.		<a href="#">materials analyst</a> , <a href="#">robot technician</a> , <a href="#">assembler</a> , <a href="#">plant accountant</a> , <a href="#">electrician</a> , <a href="#">chemical engineers</a> , and <a href="#">design engineers</a>
<b>Artistic:</b> The artistic members of our society like to create things. They are imaginative and usually extroverted. This person might be interested in writing and creating art and would be interested in self-expression through their work.		<a href="#">materials analyst</a> , <a href="#">design engineers</a> , <a href="#">welder</a> , and <a href="#">machinists</a>



<p><b>Social:</b> A social person prefers interacting with people. He or she tends to be concerned with social problems and wants to help others. This person might be interested in teaching, explaining, and helping and would enjoy working as a team.</p>		<p><i>plant human resources manager, test engineer, sales support, and quality control</i></p>
<p><b>Enterprising:</b> Those who are enterprising lean toward leadership roles. They are willing to take on challenges and are extroverted. They can be aggressive as well. This person might be interested in selling and managing and would enjoy working in business and leadership.</p>		<p><i>chief manufacturing executive, chief quality control executive, facilities manager, manufacturing manager, supervisory, and plant operator</i></p>
<p><b>Conventional:</b> Someone who is conventional prefers structured tasks and tending to details. He or she is often conservative. This person might be interested in setting up procedures, organizing, using computers, and keeping records and would enjoy working with information and finances.</p>		<p><i>assembler, shift supervisor, accounting, and manufacturing manager</i></p>

Sources:

O\*Net. [My Next Move](#). Created for the US Department of Labor, Employment and Training Administration.

Zunker, Vernon G. and Norris, Debra S. *Using Assessment Results for Career Development*. Pacific Grove, CA: Brooks/Cole Publishing Company. 1997.



## Additional Job Information

### Engineering

Chemical Engineer  
Electrical Engineer  
Industrial Engineer  
Computer Engineer  
Mechanical Engineer  
Environmental Engineer  
Aerospace Engineer

### Professional

Sales Support  
Accounting/Finance  
Supervisory  
Manufacturing Manager  
Human Resources

### Skill Trades

Electrician  
Machinists  
Welder  
Mechanic



## Chemical Engineer

### What is a Chemical Engineer?

Chemical engineers apply the principles of chemistry, biology, physics, and math to solve problems that involve the production or use of chemicals, fuel, drugs, food, and many other products. They design processes and equipment for large-scale safe and sustainable manufacturing, plan and test methods of manufacturing products, and treating byproducts, and supervise production.

### How could you become a Chemical Engineer?

Chemical Engineer-Bachelors degree

In addition to a bachelor's degree, this position requires:

- Strong PC skills, including MS Access, Excel, Word, PowerPoint
- In-depth knowledge of engineering economics
- An understanding of systems modeling tools, such as Arena simulation
- Strong analytical and organizational skills
- Oral, written, and problem solving communication skills
- Strong interpersonal skills as the position requires the incumbent to deal with all levels of management; ability to work in a team environment

Chemical engineers must have a bachelor's degree in chemical engineering. Employers also value practical experience, so cooperative engineering programs, in which students earn college credit for structured job experience, are valuable as well.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Chemistry  
Physics  
Biology  
Algebra  
Trigonometry  
Calculus

### Salary Range:

\$58,830-\$154,840

### Job Outlook

Employment of chemical engineers is projected to grow 4 percent from 2012 to 2022.





## Electrical Engineer

### What is an Electrical Engineer?

Electrical engineers design, develop, test, and supervise the manufacturing of electrical equipment, such as electric motors, radar and navigation systems, communications systems, and power generation equipment. They also design and develop electronic equipment, such as broadcast and communications systems—from portable music players to global positioning systems (GPS).

### How could you become an Electrical Engineer?

Electrical Engineer- Bachelors degree

In addition to a bachelor's degree, this position requires:

- Strong computer skills, including MS Access, Excel, Word, PowerPoint
- In-depth knowledge of engineering economics
- An understanding of systems modeling tools, such as Arena simulation
- Strong analytical and organizational skills
- Oral, written, and problem solving communication skills

Electrical and electronics engineers must have a bachelor's degree. Employers also value practical experience, so participation in cooperative engineering programs, in which students earn academic credit for structured work experience, is valuable as well.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Physics

Algebra

Drafting

Electronics engineering

Electrical engineering technology

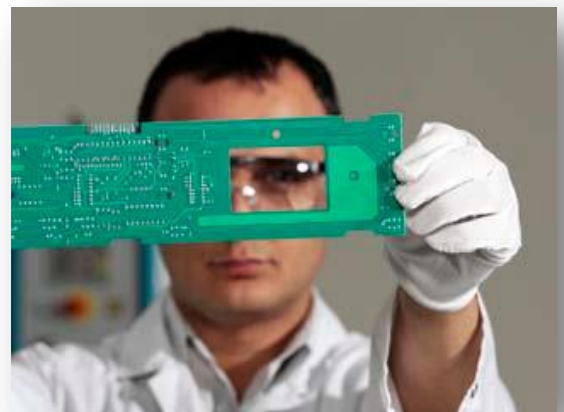
Digital systems design

### Salary Range:

\$56,490-\$136,690

### Job Outlook

Employment of electrical and electronics engineers is projected to grow 4 percent from 2012 to 2022. Job growth is expected because of electrical and electronics engineers' versatility in developing and applying emerging technologies.





## Industrial Engineer

### What is an Industrial Engineer?

Industrial engineers find ways to eliminate wastefulness in production processes. This position acts as a primary resource for accomplishing Industrial Engineering tasks associated with problem solving, data analysis, statistical analysis, business strategy development, capacity planning, inventory/cost reduction, engineering econ analysis, and systems modeling.

### How could you become an Industrial Engineer?

Industrial Engineer-Bachelors degree

In addition to a bachelor's degree, this position requires:

- Strong PC skills, including MS Access, Excel, Word, PowerPoint
- In-depth knowledge of engineering economics
- An understanding of systems modeling tools, such as Arena simulation
- Strong analytical and organizational skills
- Oral, written, and problem solving communication skills
- Strong interpersonal skills as the position requires the incumbent to deal with all levels of management; ability to work in a team environment

Industrial engineers need a bachelor's degree, typically in industrial engineering. However, many industrial engineers have degrees in mechanical engineering, manufacturing engineering, industrial engineering technology, or general engineering.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Mechanical engineering

Manufacturing engineering

General engineering

Algebra

Chemistry

Physics

Computer science

### Salary Range:

\$51,180-\$118,300

### Job Outlook

Employment of industrial engineers is projected to grow 5 percent from 2012 to 2022. This occupation is versatile both in the kind of work it does and in the industries in which its expertise can be put to use.







## Computer Engineer

### What is a Computer Engineer?

Computer hardware engineers research, design, develop, and test computer systems and components such as processors, circuit boards, memory devices, networks, and routers. They often work in research laboratories that build and test various types of computer models and most work in high-tech manufacturing firms.

### How could you become a Computer Engineer?

Computer Engineer- Bachelors degree

In addition to a bachelor's degree, this position requires:

- Strong PC skills, including MS Access, Excel, Word, PowerPoint
- In-depth knowledge of engineering economics
- An understanding of systems modeling tools, such as Arena simulation
- Strong analytical and organizational skills
- Oral, written, and problem solving communication skills
- Strong interpersonal skills as the position requires the incumbent to deal with all levels of management; ability to work in a team environment

Most computer hardware engineers need a bachelor's degree from an accredited program.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Computer engineering

Computer science

Physics

Algebra

Calculus

### Salary Range:

\$63,970-\$150,130

### Job Outlook

Employment of computer hardware engineers is projected to grow 7 percent from 2012 to 2022. A limited number of engineers will be needed to meet the demand for new computer hardware because more of the technology innovation takes place with software than with hardware.





## Mechanical Engineer

### What is a Mechanical Engineer?

Mechanical engineers design, develop, build, and test mechanical and thermal devices, including tools, engines, and machines. Mechanical engineers design and oversee the manufacturing of many products ranging from medical devices to new batteries. They provide day-to-day, technical and practical engineering advice, problem solving and support to operations and maintenance.

### How could you become a Mechanical Engineer?

Mechanical Engineer- Bachelors degree

In addition to a bachelor's degree, this position requires:

- Strong PC skills, including MS Access, Excel, Word, PowerPoint
- In-depth knowledge of engineering economics
- An understanding of systems modeling tools, such as Arena simulation
- Strong analytical and organizational skills
- Oral, written, and problem solving communication skills
- Strong interpersonal skills as the position requires the incumbent to deal with all levels of management; ability to work in a team environment

Mechanical engineers need a bachelor's degree. A graduate degree is typically needed for promotion into managerial positions. Mechanical engineers who sell services publicly must be licensed in all states and the District of Columbia.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Mechanical engineering  
Mechanical engineering technology  
Life sciences  
Physical sciences  
Basic engineering  
Algebra

### Salary Range:

\$52,030-\$121,530

### Job Outlook

Employment of mechanical engineers is projected to grow 5 percent from 2012 to 2022. Job prospects may be best for those who stay abreast of the most recent advances in technology.





## Environmental Engineer

### What is an Environmental Engineer?

Environmental engineers use the principles of engineering, soil science, biology, and chemistry to develop solutions to environmental problems. They are involved in efforts to improve recycling, waste disposal, public health, and water and air pollution control.

### How could you become an Environmental Engineer?

Environmental Engineer- Bachelors degree

In addition to a bachelor's degree, this position requires:

- Strong PC skills, including MS Access, Excel, Word, PowerPoint
- In-depth knowledge of engineering economics
- An understanding of systems modeling tools, such as Arena simulation
- Strong analytical and organizational skills
- Oral, written, and problem solving communication skills
- Strong interpersonal skills as the position requires the incumbent to deal with all levels of management; ability to work in a team environment

Environmental engineers must have a bachelor's degree in environmental engineering or a related field, such as civil, chemical, or general engineering. Employers also value practical experience. Therefore, cooperative engineering programs, which provide college credit for structured job experience, are valuable as well. Getting a license improves the chances of employment.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Environmental engineering (or related field such as civil, chemical, or general engineering)

Life sciences

Physical sciences

Algebra

### Salary Range:

\$49,150-\$122,290

### Job Outlook

Employment of environmental engineers is projected to grow 15 percent from 2012 to 2022. State and local government concerns regarding water should lead to efforts to increase the efficiency of water use.





## Aerospace Engineer

### What is an Aerospace Engineer?

Aerospace engineers design aircraft, spacecraft, satellites, and missiles. In addition, they test prototypes to make sure that they function according to design. They collaborate around activities to develop, evaluate and validate advanced structural concepts for improved aircraft structures. The position requires communicating with aerospace customers and working with customer integrated product teams and the work includes all aspects of design, analysis, manufacturing, and testing of advanced structural concepts.

### How can you become an Aerospace Engineer?

Aerospace or Structural Engineer Bachelor's degree

In addition to a bachelor's degree, this position requires:

- Strong PC skills, including MS Access, Excel, Word, PowerPoint
- In-depth knowledge of engineering economics
- An understanding of systems modeling tools, such as Arena simulation
- Strong analytical and organizational skills
- Oral, written, and problem solving communication skills
- Strong interpersonal skills as the position requires the incumbent to deal with all levels of management; ability to work in a team environment

Aerospace engineers must have a bachelor's degree in aerospace engineering or another field of engineering or science related to aerospace systems. Some aerospace engineers work on projects that are related to national defense and thus require security clearances.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Chemistry

Physics

Math

Algebra

Calculus

### Salary Range:

\$65,450-\$149,120

### Job Outlook

Employment of aerospace engineers is projected to grow 7 percent from 2012 to 2022. Some aerospace engineers work on projects that are related to national defense and thus require security clearances.





## Sales Support

### What is Sales Support?

Wholesale and manufacturing sales representatives sell goods for wholesalers or manufacturers to businesses, government agencies, and other organizations. They contact customers, explain product features, answer any questions that their customers may have, and negotiate prices. They coordinate with production scheduling materials to meet the needs of the customers and enter customer orders and deliveries in computer system. Sales representatives identify, research, and resolve customer issues and follow-up on customer inquiries.

### How can you achieve a position in Sales Support?

High School Graduate

GED

Bachelor's degree

This position requires a candidate be:

Detail oriented

Have strong organizational skills

Have strong communication skills

Computer proficiency in Windows, Word and Excel

Educational requirements vary, depending on the type of product sold. If the products are not scientific or technical, a high school diploma is generally enough for entry into the occupation. If the products are scientific or technical, sales representatives typically need at least a bachelor's degree.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

A degree in a field related to the product sold, such as chemistry, biology, or engineering, is often required.

Sales techniques

Marketing

Economics

Communication

Foreign language

### Salary Range:

\$37, 270-\$147,320

### Job Outlook

Employment of wholesale and manufacturing sales representatives is projected to grow 9 percent from 2012 to 2022. Employment growth for sales representatives is expected to follow the economy as a whole.





## Accounting/Finance

### What is Accounting/Finance?

Accountants and auditors prepare and examine financial records. This position examines financial statements to ensure that they are accurate and comply with laws and regulations. They monitor actual versus planned costs and identify opportunities to spend less money. Accountants perform financial analysis on departmental spending, job cost, and shop floor transactions.

### How can you achieve a position in Accounting/Finance?

High School Graduate  
GED  
Bachelor's degree

Most employers require a candidate to have a bachelor's degree in accounting or a related field. Certification within a specific field of accounting improves job prospects. For example, many accountants become Certified Public Accountants (CPAs).

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Accounting  
Business administration  
Internal auditing  
Algebra  
Economics

### Salary Range:

\$39,930-\$111,510

### Job Outlook

Employment of accountants and auditors is projected to grow 13 percent from 2012 to 2022. In general, employment growth of accountants and auditors is expected to be closely tied to the health of the overall economy. As the economy grows, these workers will continue to be needed to prepare and examine financial records.





## Supervisor

### What is a Supervisor?

The position is accountable for providing leadership and direction to hourly team members in order to meet business requirements for the efficient production of products in a team-driven, lean manufacturing environment.

### How can you achieve a position as a Supervisor?

High School Graduate

GED

Associates Degree preferred in related field; plus 2 years manufacturing supervisory experience

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Business administration

Industrial engineering

Master of Business Administration

### Salary Range:

\$54,250-\$150,020

### Job Outlook

Employment of industrial production managers is projected to show little or no change from 2012 to 2022.





## Manufacturing Manager

### What is a Manufacturing Manager?

Industrial production managers oversee the daily operations of manufacturing and related plants. They coordinate, plan, and direct the activities used to create a wide range of goods, such as cars, computer equipment, or paper products. Location Managers will have direct responsibility for the manufacturing organization, manufacturing support, process excellence and quality, with a focus on driving improvements in cost, quality, time, safety and people. They develop manufacturing operating plans in accordance with company policies, goals and objectives and ensure operation plans achieve targeted cost and efficiency results that maximize value for the business unit.

### How can you achieve a position as a Manufacturing Manager?

Bachelor's degree plus 10 years manufacturing leadership

A bachelor's degree is required for most advertising, promotions, and marketing management positions. These managers typically have work experience in advertising, marketing, promotions, or sales.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Industrial engineering  
Master of Business Administration  
Business administration

### Salary Range:

\$54,250-\$150,020

### Job Outlook

Employment of industrial production managers is projected to show little or no change from 2012 to 2022.







## Human Resources

### What is a Human Resource Specialists?

Human resources specialists recruit, screen, interview, and hire workers. They often handle other human resources work, such as those related to employee relations, payroll and benefits, and training. Human resources specialists support the team in the recruitment of talent ensuring all HR processes are followed from the time a new position is available to the time someone is hired. They support college campus recruiting activities and plans and positive employee relations, acting as advocate on behalf of employees.

### How can you achieve a position as a Human Resource Specialists?

Applicants must usually have a bachelor's degree in human resources, business, or a related field. However, the level of education and experience required varies by position and employer.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Human resources

Business

Professional writing

Human resource management

Accounting

English courses including writing

### Salary Range:

\$32,770-\$95,380

### Job Outlook

Employment of human resources specialists and labor relations specialists is projected to grow 7 percent from 2012 to 2022. Prospects for human resources specialists are expected to be favorable, but those for labor relations specialists are expected to be less favorable.





## Electrician

### What is an Electrician?

Electricians install, maintain, operate or repair all electrical equipment. They are familiar with industrial motors and controls; wire and troubleshoot.

### How could you become an Electrician?

High School Graduate

GED

Technical/Vocational School

Two-year associate's degree

Although most electricians learn through an apprenticeship, some start out by attending a technical school. Most states require electricians to be licensed.

**It may be helpful to have the degrees, certificates and/or coursework listed below.**

Circuitry

Basic Electrics

Electrical engineering

Physics

### Salary Range:

\$30,420-\$82,930

### Job Outlook

Employment of electricians is projected to grow 20 percent from 2012 to 2022, faster than the average for all occupations.





## Machinist

### What is a Machinist?

Machinists study specifications such as blueprints, sketches, models, or descriptions, and visualize product to determine materials required and machines to be used to fabricate parts. They calculate dimensions and tolerances using knowledge of mathematics and instruments such as micrometers and vernier calipers. Machinists' measure, mark, and scribe dimensions and reference points on metal stock for machining. They set up and operate machine tools such as lathes, milling machines, and grinders, to machine parts, and verifies conformance of machined parts to specifications.

### How could you become a Machinist?

High School Graduate

GED

Technical/Vocational School

Two-year associate's degree

Machinists train in apprenticeship programs, vocational schools, community and technical colleges, or informally on the job.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Algebra

Geometry

Metalworking

Drafting

Physics

Calculus

### Median Salary:

\$33,380-\$76,690

### Job Outlook

Employment of machinists and tool and die makers is projected to grow 7 percent from 2012 to 2022. Workers with computer skills who can perform multiple tasks in a machine shop will have the best job opportunities.





## Welder

### What is a Welder?

Welders weld various thicknesses of round, square, rectangular tubing and support structures. They use wire welding machines, band saw and iron working tools. Welders lay out sheet metal and read blue prints and schematics.

### How could you become a Welder?

High School Graduate

GED

Technical/Vocational School

Two-year associate's degree

Training for welding, cutting, soldering, and brazing workers varies. Training ranges from a few weeks of technical school or on-the-job training to several years of combined technical school and on-the-job training.

### It may be helpful to have the degrees, certificates and/or coursework listed below.

Welding, soldering, or brazing certification

Mechanical drawing

Physics

Chemistry

Shop mathematics

Basic computer classes

### Salary Range:

\$24,720-\$56,130

### Job Outlook

Employment of welders, cutters, solderers, and brazers is projected to grow 6 percent from 2012 to 2022.





## Mechanic

### What is a Mechanic?

Mechanics analyze malfunctions and repair, rebuild, and maintain equipment. They operate and inspect machines and equipment to diagnose defects. Mechanics dismantle and reassemble equipment using hoists, as well as hand and power tools. They examine parts for damage or excessive wear, using micrometers and gauges. They replace defective engines and subassemblies, such as transmissions, electric motors, drums, seals, hydraulic pumps, valves, pistons, rods, gears, crankshafts, and cylinder blocks. Machinists test overhauled equipment to ensure operating efficiency and must be able to operate all equipment.

### How could you become a Mechanic?

High School Graduate

GED

Technical/Vocational School

Two-year associate's degree

A high school diploma or the equivalent is typically the minimum requirement to work as an automotive service technician or mechanic. Because automotive technology is becoming increasingly sophisticated, some employers prefer automotive service technicians and mechanics who have completed a formal training program in a postsecondary institution. Industry certification usually is required once the person is employed.

**It may be helpful to have the degrees, certificates and/or coursework listed below.**

Automotive repair

Electronics

Computers

General English courses

Basic mathematical courses

Automotive technology services

### Salary Range:

\$20,810-\$60,070

### Job Outlook

Employment of automotive service technicians and mechanics is projected to grow 9 percent from 2012 to 2022.

