Unmanned underwater vehicles

AUV: autonomous underwater vehicles
ROV: remotely operated underwater vehicles

This industry involves companies that manufacture Autonomous Underwater Vehicles (AUV). AUVs are vessels that can travel underwater without an operator on their own source of power. AUVs are used in commercial industries (oil and gas), for military missions as well as for research purposes.

This industry provides maintenance services for AUV as well as manufactures AUVs in different configurations for depths less than 200m as well as greater than 200m.

Furthermore, the products (AUVs) are divided into three categories:

1. 200 meters+ depth of water (30% of the market)
2. Up to 200 meters depth of water (40%)
3. Up to 30 meters of water (30%)

Related Industries:

- 33451a Navigational Instrument Manufacturing in the US
- 33641b Space Vehicle & Missile Manufacturing in the US
- 48833 Tugboat & Shipping Navigational Services in the US

Resources:

- **www.auvac.org,** Association for Unmanned Vehicle Systems International
- **www.auvsi.org,** Autonomous Undersea Vehicle Applications Center
- **www.marinelink.com,** Maritime Reporter

Autonomous Underwater Vehicle Manufacturing in the US

Industry Size	IBIS World
Revenue	$ 156.9m
Profit	$ 11.5m
Annual Growth rate (08-13)	13.8%
Expected annual growth rate (13-18)	17.2%
Exports	$ 8.3m
Businesses	8
Key Drivers	• Federal funding for defense • Research and development expenditure • Demand from oil drilling and gas extraction • Trade-weighted index

Industry Structure	
Life Cycle Stage	Growth
Capital Intensity	Low
Regulation Level	Heavy
Barriers to entry	High
Competition	Medium
	Commercial (oil and gas) use of AUV will contribute to growth in the next five years. However, a decline in defense spending will likely mitigate growth, since military applications are the main market for this industry.
	AUVs are used for • Surveillance • Reconnaissance • Mine countermeasures • Anti- submarine warfare • Mapping of the ocean floor • Testing water samples • Polar ice research • Pipeline inspection
	AUVs are replacing Remotely Operated Vehicles (ROVs), which do not have their own power source and are controlled by an operator directly.
	50% of sales are from the military (http://www.cggc.duke.edu/pdfs/2012-09-01_Brun_ROV_AUVtrends_MarineTechnologyReporter.pdf) 30% scientific research 20% oil and gas development
Outlook	Industry growth will remain constant even though military spending will be reduced. Commercial applications in the oil and gas industry will fuel the growth of this industry in the next five years. Companies will increase investing into offshore oil and gas drilling and in particular for depths of 500 and more meters. AUVs are a more cost effective alternative to ROVs because they do not require a surface vessel and can operate autonomously.
	This industry is a net importer. Imports will rise.
Supply Chain	
Buying Industries	• Oil Drilling & Gas Extraction in the US • Scientific Research & Development in the US • Colleges & Universities in the US

	• Public Administration in the US
Selling Industries	• Molybdenum & Metal Ore Mining in the US • Iron & Steel Manufacturing in the US • Computer Manufacturing in the US • Semiconductor & Circuit Manufacturing in the US • Circuit Board & Electronic Component Manufacturing in the US
Products and Services	Very high price tag, averaging $1 million for higher-end models.
Demand	• Government military funding will decline • Increase in commercial use • Large sums of R&D required for developing new products. • Intellectual property protecting is important
Market segmentation	30% AUVs operating in up to 30m of water 40% AUVs operating in up to 200m of water 30% AUVs operating in greater than 200m of water (of $156.9m)
Markets	50% Military/Security 30% Scientific Research 20% Commercial
Business Locations	• California (36.4%) • Massachusetts (27.3%), Boston (Bluefin, iRobot and Kongsberg) • Texas (9.1 %) • New York (9.1 %) • Florida (9.1 %) • Washington (9.1 %) (Boeing)
Market Concentration	Medium. Concentrated around scientific and military research
Key Success Factors	• Access to highly skilled workforce • Ability to quickly adopt new technology • Economies of scale • Ability to expand and curtail operations rapidly in line with market demand
Competition	Medium. Increasing. 8 established firms in the US. Large international competitors.
Barriers to Entry	High. • High degree of specialization

	• R&D investments • High fixed costs • Measuring and control instruments • Firms must be able to comply with government regulations • High cost of insurance • High skilled labor required to operate AUVs. • Difficult to enter as a small firm, because large established companies control the market and have established relationships with distributors and manufacturers. • Additionally, economies of scale are another factor.
Globalization	Medium. Increasing. Foreign ownership in the US. 'Kongsberg Maritime' (Norway), ISE Ltd. (Canada). US firms (Boeing, Raytheon) have large production facilities abroad and sell abroad. Established subsidiaries in foreign countries. Firms are expected to expand their operations globally in the next five years, especially to capitalize in faster growing economies.
Major Companies	• Kongsberg Maritime 30.6% • The Boeing Company 14.4% • Bluefin Robotics 13.7% • Raytheon Company 4.5% • Others 36.8%
Technology Change	Reduced power requirement for equipment. Increased battery life. Alternate power sources (solar). Buoyancy changes of gliders and propellers
Capital Intensity	Low. "On average, industry operators only spend about $0.07 on capital expenditures for every dollar spent wages." (IBIS OD4420, p. 28). High labor cost
Revenue Volatility	Medium. Military spending has low volatility, but downstream industries (oil and gas) have a high degree of volatility, due to changes in oil prices.
Regulation & Policy	Heavy. Increasing level of international, federal, state and local. • Limit on export for military uses. • Environmental Protection Agency • Federal Trade Commission • US Department of State and Defense

	Safety standards • Safety and environmental standards • Energy-efficiency standards • Test procedures If manufacturers do not comply with theses standards hefty fines are issued which can impact operations greatly. • Government and procurement regulations
Industry Assistance	Medium. Defense departments provide more funding for research and development because the use of AUVs has become more efficient (anti-submarine warfare, mine detection) Other assistance from Association for Unmanned Vehicle Systems International for R&D and robotic technologies.

Industry Data

	Revenue ($m)	Industry Value Added ($m)	Establish-ments	Enterprises	Employment	Exports ($m)	Imports ($m)	Wages ($m)	Domestic Demand ($m)	Federal Funding for Defense ($b)
2004	47.0	20.2	10	8	420	11.4	7.1	15.9	42.7	541.4
2005	50.6	22.2	10	9	439	10.2	8.3	16.8	48.7	569.5
2006	58.2	24.3	11	9	479	12.1	9.9	18.9	56.0	581.4
2007	70.1	28.6	12	9	537	10.7	14.1	22.1	73.5	596.9
2008	82.3	33.3	11	9	593	10.1	14.8	25.2	87.0	652.3
2009	87.7	33.2	11	8	617	6.0	14.2	26.6	95.9	692.9
2010	103.3	37.4	11	9	682	6.9	13.8	30.5	110.2	718.4
2011	114.6	41.8	10	8	734	8.2	13.3	33.3	119.7	716.1
2012	133.5	48.6	11	8	788	8.1	15.6	36.6	141.0	716.3
2013	156.9	56.2	11	8	866	8.3	17.3	41.8	165.9	701.8
2014	174.2	61.4	11	8	918	8.2	19.2	45.2	185.2	599.3
2015	199.8	68.8	11	8	990	8.3	21.7	50.0	213.2	572.5
2016	228.5	76.8	11	8	1,063	8.2	24.3	55.1	244.6	578.3
2017	280.6	90.7	11	9	1,174	8.2	26.8	63.5	299.2	589.5
2018	346.8	108.9	12	9	1,335	8.0	29.4	75.0	368.2	598.2

Useful sources:
http://www.cggc.duke.edu/pdfs/2012-09-01_Brun_ROV_AUVtrends_MarineTechnologyReporter.pdf

Autonomous Undersea Vehicle Application Center, http://auvac.org/

http://www.nauticalcharts.noaa.gov/csdl/AUV.html

ROV manufacturing

Companies

- Kongsberg Maritime, manufactures parts for AUV
- C&C Technologies, AUVs, (http://www.cctechnol.com/), Lafayette, LA
- ACSA Aclen, Sea Explorer, underwater glider (http://www.acsa-alcen.com/) , France
- FESTO, robotics, Germany

- Webb Research, gliders, current sensors, (http://www.webbresearch.com/) North Falmouth, MA
- Teledyne, digital imaging, defense electronics, California
- SeaBotix, underwater robots (remotely operated), (http://www.seabotix.com/index.html) San Diego, CA
- Northrop Grumman, Defense, also manufacture underwater vehicles, Falls Church, VA
- EvoLogics, Bionic Manta Ray, Berlin, Germany
- Raytheon, Arlington, VA

Research Institutions: (http://www.transit-port.net/Lists/AUVs.Org.html)

Manufacturers – AUVAC database: (http://auvac.org/explore-database/advanced-search/results_purpose#)

AUV

Company	Location
ACSA – ALCEN	France
ANT, LLC	Alaska
Atlas Elektronik	Germany
ATLAS MARIDAN	Denmark
BAE Systems	England
Bluefin Robotics	Quincy, MA
Boeing Defense, Space & Security	Anaheim, CA
Columbia Group	Washington, DC
Cybernetix	France
Daewoo Shipbuilding & Marine Engineering Co., Ltd.	Korea
ECA SA	France
Evo Logics	Germany
Exocetus	Anchorage, AK
Falmouth Scientific, Inc	Cataumet, MA
Festo	Hauppauge, NY
Hydroid	Pocasset, MA
Hawkes Remotes (acquired by Bluefin)	Point Richmond, CA
Independent Robotics Inc.	Canada
International Submarine Engineering	Canada
iRobot Maritime Systems	Bedford, MA
Kongsberg Maritime	Norway
Kongsberg Underwater Technology Inc.	Lynnwood, WA
Liquid Robotics	Sunnyvale, CA
Lockheed Martin, Maritime Systems and Sensors	Riviera Beach FL
Marlin Submarines	England
Marport	Canada
MetOcean Data Systems	Canada

Mitsui Engineering and Shipbuilding	Japan
Ocean Aero	San Diego, CA
OceanScan MST	Portugal
OceanServer Technology	Fall River, MA
QinetiQ North America	Waltham, MA
Saab Seaeye	England
Stone Aerospace	Del Valle, TX
Subsea 7	UK
Teledyne Gavia	Iceland
Teledyne Webb Research	Falmouth, Ma
Thales	France
USM Underwater Robotics Research Group	Malaysia

ROV (http://www.rov.org/industry_manufacturers.cfm)

Company	Location
Ageotec	Italy
Aquabotix	Fall River, MA
Atlas Maridan	Germany
BMTI	France
Deep Ocean Engineering, Inc.	San Jose, CA
Deep Sea Systems International (DSSI)	Falmouth, MA
Deep Trekker	Canada
Desistek Robotics Ltd.	Turkey
DOER Marine	Alameda, CA
DWTEK Co. Ltd	Taiwan
ECA CSIP	UK
ECA Robotics	Frane
EPRONS ROV Ltd	Lativa
Submersible Systems	Patterson, LA
GNOM	Russia
Hydroacoustics, Inc.	Spain
Hydroid (Kongsberg)	Norway
Imenco	Norway
International Submarine Engineering (ISE)	Canada
I-Tech	Katy, TX
JINPAT Electronics Co., Ltd	China
LBO, Inc.	Norway
Marine Exploration Services	Bothell, WA
Mariscope	Germany
Moog Inc.	International
Neptun Subsea	Norway
Oceaneering International	Houston, TX
Outland Technology Inc.	Slidell, LA
Pegasus International PDX Inc.	Portland, OR

Perry Slingsby Systems **(Forum)**	Houston, TX
R.OV. Technologies	Brattleboro, VT
Rov Specialties	Cleveland, OH
Rovtech Systems	UK
SAAB Seaeye	England
Saipem America	?
SBG Systems	France
Schilling Robotics	Houson, TX
SeaBotix	San Diego, CA
Seamor Marine	Canada
Shark Marine Technologies	Canada
SMD	UK
Specialist Services	Dubai
Sub-Atlantic **(Forum)**	Houson, TX
Submersible Systems, Inc	Patterson, LA
Syscustom Corp	China
Teledyne Benthos	Capa Cod, MA
Trelleborg Offshore	UK
Underwater Solutions	UK
Video Ray	Pottstown, PA

US Companies: Consolidated List

Company	Location	
ANT, LLC	Alaska	AUV
Aquabotix	Fall River, MA	ROV
Bluefin Robotics	Quincy, MA	AUV
Boeing Defense, Space & Security	Anaheim, CA	AUV, ROV
C & C Technologies	Lafayette, LA	AUV
Columbia Group	Washington, DC	AUV
Deep Ocean Engineering, Inc.	San Jose, CA	ROV
Deep Sea Systems International (DSSI)	Falmouth, MA	ROV
DOER Marine	Alameda, CA	ROV
Exocetus	Anchorage, AK	AUV
Falmouth Scientific, Inc	Cataumet, MA	AUV
Forum Energy Technologies	Houston, TX	ROV
Festo	Hauppauge, NY	AUV
General Dynamics, Advanced Information Systems	Fairfax, VA	AUV
Hawkes Remotes (acquired by Bluefin)	Point Richmond, CA	AUV
Hydroid	Pocasset, MA	AUV
I-Tech	Katy, TX	ROV

iRobot Maritime Systems	Bedford, MA	AUV
Kongsberg Underwater Technology Inc.	Lynnwood, WA	AUV
Liquid Robotics	Sunnyvale, CA	AUV
Lockheed Martin, Maritime Systems and Sensors	Riviera Beach FL	AUV
Marine Exploration Services	Bothell, WA	ROV
Northrop Grumman, Defense	Falls Church, VA	ROV
Ocean Aero	San Diego, CA	AUV
Oceaneering International	Houston, TX	ROV
OceanServer Technology	Fall River, MA	AUV
Outland Technology Inc.	Slidell, LA	ROV
Pegasus International PDX Inc.	Portland, OR	ROV
QinetiQ North America	Waltham, MA	AUV
Raytheon	Arlington, VA	
R.OV. Technologies	Brattleboro, VT	ROV
Rov Specialties	Cleveland, OH	ROV
Schilling Robotics	Houson, TX	ROV
SeaBotix	San Diego, CA	ROV
Stone Aerospace	Del Valle, TX	AUV
Submersible Systems, Inc	Patterson, LA	ROV
Teledyne Benthos	Capa Cod, MA	ROV
Teledyne Webb Research	Falmouth, Ma	AUV
Video Ray	Pottstown, PA	ROV

Virginia:

Company	Location	
Northrop Grumman, Defense	Falls Church, VA	ROV
Raytheon	Arlington, VA	

Company Analysis

Bloomberg

Firm Characteristics	Raytheon (RTN)
Revenues	
Employees	
Market share	
Market capitalization	
Profits	
Value of business	
Exports	
R&D Funding	
Major Customer	
Major Supplier	
Major Products/ Services	

Firm Characteristics	Northrop Grumman Corporation (NOC)
Revenues	$24,661m (12-2013)
Employees	
Market share	
Market capitalization	24,939 (2013)
Profits	
Value of business	
Exports	
R&D Funding	
Major Customer	
Major Supplier	
Major Products/ Services	

Firm Characteristics	Bluefin Robotics
	Since 2005 a subsidiary of Battelle Memorial Institute, Inc.
Revenues	$ 12m
Employees	50
Market share	

Market capitalization	
Profits	
Value of business	
Exports	Products are in accordance with export standards.
R&D Funding	
Major Customer	
Major Supplier	
Major Products/ Services	• AUV for shallow water depths • AUV for mid-water depths • AUV for deep water depths • Subsea battery • Spray glider (buoyancy driven AUV) • Hovering AUV (HAUV)
NAISC Code	483111
SIC Code	4440
Usage of products (http://www.bluefinrobotics.com/applications/)	Commercial • Inshore Survey • Offshore Survey • Search and Salvage Scientific • Oceanography • Archaeology and Exploration • Environmental Protection and Monitoring • Scientific Research Defense • Port and Harbor Security • Ship Hull and Infrastructure Inspection • Mine Countermeasures (MCM) • Unexploded Ordnance (UXO) • Rapid Environmental Assessment (REA) • Anti-Submarine Warfare (ASW) • Intelligence, Surveillance and Reconnaissance (ISR) •
	• Owns SeeByte, which helps military and commercial users to improve navigation software for unmanned underwater vehicles

Military applications of unmanned underwater vehicles:

- Anti-submarine warfare
- Barrier control
- Communication
- Detection of vessels
- Emitting jamming
- False data transmission
- Identification
- Information operations
- Inspection
- Mine detection
- Mine neutralization
- Navigation
- Oceanography
- Overall support of military vessels and ports (offense and defense)
- Reconnaissance
- Seafloor mapping
- Spying (Sonar, Sensors, Radar)
- Surveillance
- Time critical strikes
- Transportation

(http://www.navy.mil/navydata/technology/uuvmp.pdf)