

THE ROBO GLOBAL[®] INDUSTRY CLASSIFICATION

ROBO GLOBAL DATABASE

ROBO Global created and maintains a unique database of global companies that have a portion of their business and revenue associated with robotics, automation, and artificial intelligence (RAAI). Our database has well over a decade of history and captures the entire value chain of RAAI and other enabling technologies specific to the overall investment opportunity. At ROBO Global, our exclusive focus combined with our access to a unique coverage team of robotics industry experts and financial professionals allows us to identify, research and, when needed, meet with potential database members.

ROBO GLOBAL INDUSTRY CLASSIFICATION

In the absence of a benchmark industry classification system for identifying companies engaged in the global RAAI industry, we created the ROBO Global Industry Classification in consultation with industry experts from our Advisory Board. The ROBO Global Industry Classification was launched in 2013 and is designed for the investment and research community as it identifies subsectors of suitable product and technology maturity within the RAAI theme that carry high growth and earnings potential.

As the RAAI opportunity continues to develop and advance, so will the subsectors within the ROBO Global Industry Classification. Currently, we focus on 12 subsectors, and within each subsector we identify areas of specific focus and high growth potential. To date, 4 of the subsectors relate to 'Technology' and 8 relate to 'Applications.'

The ROBO Global Industry Classification is maintained by the ROBO Global Industry Classification Committee. The Committee convenes at least once each quarter and engages in regular dialogue with the ROBO Global Advisory Board members.

To qualify for membership in the ROBO Global Industry Classification, companies must pass the following multi-step screening process:

1. Companies must be included in the ROBO Global Database.
2. All non-publically traded companies are excluded.
3. If a company's product, technology, services or business model do not fit into one of the 12 subsectors then they are excluded. (See below for further details on subsectors.)
4. Companies must have a minimum threshold of revenue related to the RAAI theme. If a company falls below this threshold, it is excluded.
5. Within their specific subsector, companies must be in a position of product and technology leadership and be able to demonstrate growth potential.
6. Companies that do not pass the ROBO Global ESG Policy are excluded. (Read our current ESG policy at www.roboglobal.com.)

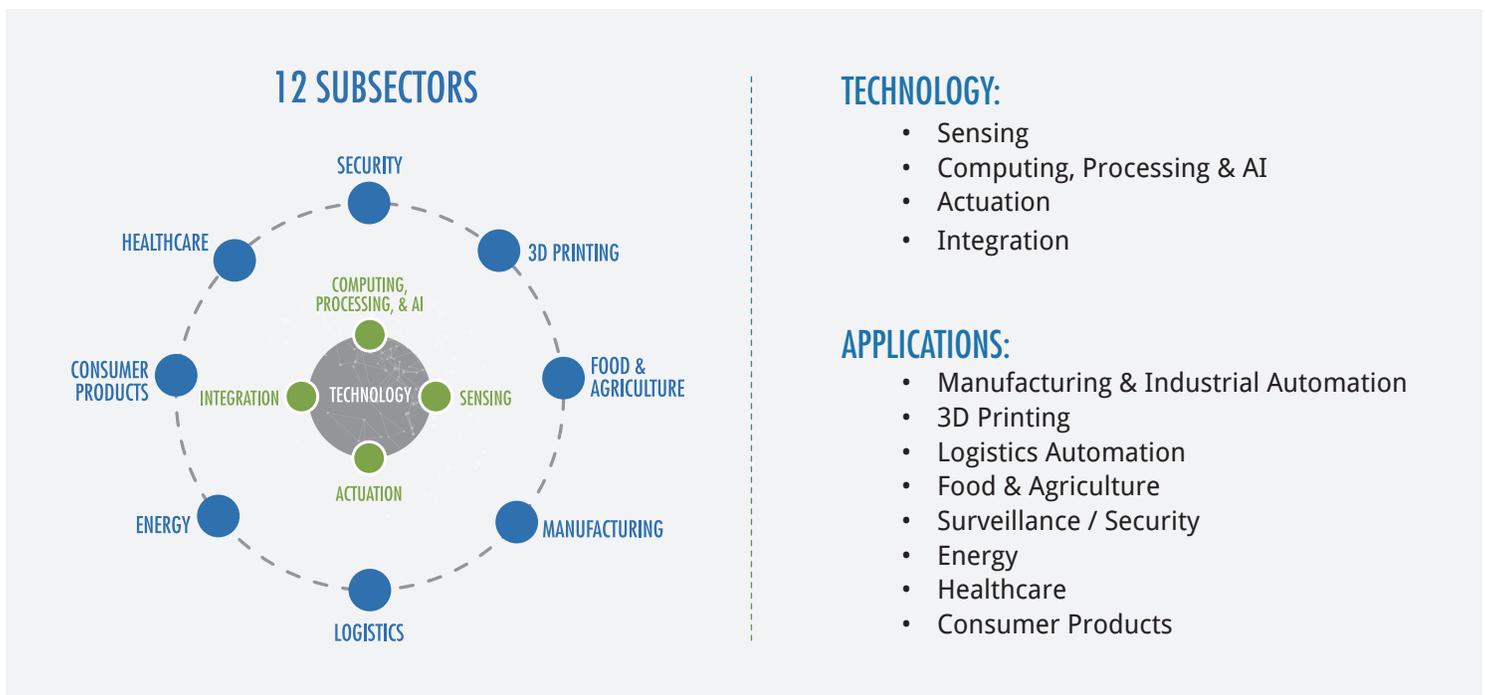
All companies classified under the ROBO Global Industry Classification will be classified as either 'bellwether' or 'non-bellwether.' Bellwether companies are well-established leading companies whose core business is directly related to robotics and automation; typically these operate on a global scale. These companies are also referred to as 'pure play' companies. Non-bellwether companies have a distinct portion of their business and revenue in robotics and automation and the potential to grow within this space through innovation and/or market adoption of their products and/or services. Companies who believe they are eligible for inclusion in the ROBO Global Industry Classification System under the rules above, or that they are more appropriately classified in a different subsector, should apply in writing to info@roboglobal.com.

FOCUS CATEGORIES & SUBSECTORS

Companies within the ROBO Global Industry Classification are categorized as having either a 'Technology' or 'Applications' focus:

- **Technology** includes companies that enable robots to sense, process, and act, such as those that manufacture or provide services related to any machinery, equipment, devices, or sensors supporting a robot performing a task. It also includes companies that provide key enabling software and processing technologies used to advance the conversion to autonomous systems.
- **Applications** includes companies that incorporate multiple robotic and automation technologies into a product or manufacturing process to improve efficiency in traditional business lines, as well as into the development of entirely new business propositions.

Companies are further sub-classified into the following 12 subsectors. The number of subsectors is expected to increase as the robotics, automation and AI industry continues to evolve:



TECHNOLOGY

Sensing

In order for a system to exhibit autonomy, it must be able to sense its environment and determine its own internal state. In human beings, these abilities are called exteroception and proprioception. Sensing is important for the same reasons that our exteroceptive senses (the ability to process visual, auditory, and other stimuli) and our proprioceptive senses (the ability to know where our limbs are and what they are doing without directly observing them) are important for human beings. For robotic systems, however, we are not limited to the standard senses. A sensor can be made to process almost any measurable stimuli, making the potential application of this technology incredibly vast.

Computing, Processing & Artificial Intelligence

Autonomous systems must make decisions at various levels, from determining the state of the environment they are operating in to optimally planning actions and controlling motion. An autonomous system is analogous to our brain, and is what allows the processing of information that produces actuation to take place. This requires raw computing and processing power as well as increasingly advanced software. Computing can vary from embedded systems smaller than a fingernail to hyper-scale datacenters implementing sophisticated algorithms, including Artificial Intelligence (AI). Machines are getting smarter as AI becomes increasingly pervasive. Advancements in AI, especially machine learning, are key to the growth of autonomous systems. The main advantage of AI over human intelligence is its high scalability, which results in significant cost savings. Other benefits include AI's consistency and rules-based programs, which eventually reduce errors. AI's longevity, continuous improvement and new growth opportunities are just some reasons why AI is drawing wide interest.

Actuation

Actuation is the means by which machines interact with the physical world. In human beings actuation mainly refers to our limbs, in particular our hands, but for machines we are not limited to manual manipulation. Almost anything that has an effect on the physical world can be made into an actuator. Actuation can be generated through electric, hydraulic (compressed fluid), mechanical and pneumatic (compressed air) techniques.

Integration

An autonomous system is made of up many components (sensors, actuators, and computational units) that can be distributed over large spaces. Integration consists of architecting a system – figuring out how to put all of these components together – in order to achieve a desired objective in a robust, high performance, and cost-efficient way.

APPLICATIONS

Manufacturing & Industrial Automation

Factory automation is an increasingly critical success factor in manufacturing, as businesses pursue higher productivity and lower costs in the face of global competition. Automation also means workplace safety, freeing workers from tedious manual labour to focus on strategic, high-level tasks that really use their expertise. The automotive industry was the first to deploy robotics and automation to a large extent, but many other industries are still in the early stages of adoption, offering significant growth potential.

3D Printing

Traditionally, things are built either by assembling separate parts together or by removing material from a larger workpiece. 3D printing, also known as additive manufacturing, takes a different approach by depositing different types of materials where they are needed.

One of its main benefits is the potential for economically feasible customization that is not possible with traditional techniques.

Logistics Automation

The logistics and warehouse automation industry is at an inflection point as the boom in e-commerce dramatically raises the bar for supply chain efficiency. From autonomous mobile robots and advanced storage systems to track and trace technologies, robotics and automation enables increasingly speedy, safe and error-free distribution, shorter time to market, and lower costs to businesses and consumers.

Food & Agriculture

Feeding the world continues to be one of our most important economic activities. A new generation of autonomous systems and data analytics tools are bringing the benefits of traditional automation – such as precision and the elimination of rote labour – to this domain. For example, precision agriculture can greatly reduce costs – and in the process, lower our environmental footprint – by applying water and fertilizer on an as-needed basis. Meanwhile, the food processing industry continues to automate aggressively to meet increasingly demanding volume, cost and safety requirements.

Surveillance/Security

Removing people from harm's way has always been one of the main drivers for robotics research. This has been a very difficult problem to solve because of the difficulty in duplicating through automated means the flexibility and cognitive skills that humans possess. With the new capabilities offered by today's technologies, however, unmanned aircraft and ground vehicles are now able to detect hazardous materials, dispose of bombs, operate in space and perform critical national defence functions (surveillance).

Energy

Exploration, extraction, and keeping the energy infrastructure operational require increasingly extensive resources. As robotics and automation continues to expand from structured environments – such as warehouses and factories – to unstructured ones – such as the outdoors, underground, and the ocean – the energy sector will reap the rewards of this transition mainly through much lower operational costs.

Healthcare

As healthcare costs continue to rise globally, robotics, automation and artificial intelligence is poised to provide a countering force to this trend. Using robotics and autonomous systems in areas including surgical robot platforms, rehabilitation, diagnostics, lab processing, and care for the elderly promises to drastically reduce costs and improve the quality of life for many people. In addition, as in all other application areas, robotics and automation can enable new capabilities that transcend cost-cutting, such as the use of robots to carry out many types of difficult surgeries and neurological treatments.

Consumer Products

These are companies that produce robots used for playing (such as toys and games), interaction, household cleaning, and other tasks done at home that can be automated. The Internet of Things promises to usher in a new area of interconnectivity. By communicating through the existing internet infrastructure, devices will no longer be isolated islands of limited capabilities. Through the Internet, robotics, automation and artificial intelligence will finally become broadly affordable to individuals.

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