ROBO-STOX Industry Classification: Companies within our Index are classified according to the Global Robotics and Automation Industry Classification maintained by ROBO-STOX. The ROBO-STOX Industry Classification is a definitive system for categorizing global publically listed companies within the robotics and automation industry into a number of sub-sectors which is expected to increase in number as the industry continues to evolve.

Currently, the Classification Committee has identified the following 13 sub-sectors which based on the current Index components breaks down as follows:

Technology: 40 index holdings	**Applications:** 43 index holdings
1. Sensing - 5 2. Processing - 11 3. Actuation - 12 4. Computing - 8 5. Integration - 4	6. Manufacturing & Industrial Automation - 14 7. 3D Printing - 4 8. Logistics Automation - 5 9. Agriculture - 1 10. Security - 4 11. Energy - 4 12. Healthcare - 9 13. Consumer Products - 2

*NOTE: **Bolded** companies below indicate bellwether names.*

Technology captures all index companies that manufacture or provide services related to any machinery, equipment, devices or sensors supporting a robot performing its task. It also includes those companies that provide key-enabling software and processing technologies used to advance the conversion to autonomous systems. Essentially, we are looking at the companies that enable robots to sense, process and act:

1. **Sensing** - In order for a system to exhibit autonomy, it must be able to sense its environment, in addition to determining its own internal state. For human beings, these are called exteroception and proprioception. Sensing is important for the same reasons that our exteroceptive senses (sight, sound, etc.), and our proprioceptive senses (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. Almost anything that can be measured can be made into a sensor.

    - Immersion Corp
    - **Keyence Corp**
    - **OMRON Corp**

- Renishaw plc
- Teledyne Technologies

2. **Processing** - Autonomous systems must make decisions at various levels, ranging from basic motion control, to determining the state of the environment they are operating in, to optimally planning actions. Part of this processing is thus making sense of the information received from sensors, but also planning actions in order to achieve a desired objective.

    - **Cognex Corp**
    - Dassalut Systems
    - e2v Technologies
    - **FARO Technologies**
    - FLIR Systems
    - Isra Vison
    - LEONI AG
    - Mobileye
    - National Instrument Corp
    - Nuance Communications
    - Trimble Navigation

3. **Actuation** - Actuation is the means by which machines interact with the physical world. For human beings, this mainly refers to our limbs, and in particular, our hands. However, machines are not limited to manipulation. Almost anything that has an effect on the physical world can be made into an actuator. Actuation techniques include electric, hydraulic (compressed fluid), mechanical, and pneumatic (compressed air).

    - AirTAC International Group
    - Delta Electronics Inc.
    - Harmonic Drive Systems Inc.
    - **Hiwin Technologies Corp.**
    - IPG Photonics Corporation
    - Jenoptik AG
    - Johnson Electric Holdings Ltd.
    - **Lincoln Electric Holdings Inc.**
    - **Nabtesco Corporation**
    - SMC Corp.
    - TECO Electric & Machinery Co. Ltd.
    - THK Co., Ltd.

4. **Computing** - The path from sensing, to processing, to actuation, requires computation. It is analogous to our brain, and is what allows the processing of information to produce actuation. Computing can vary from embedded systems smaller than a fingernail to server-farms implementing sophisticated algorithms.

    - Adlink Technologies
    - Advantech Co
    - Atmel Corp
    - HollySys Automation Technologies, Ltd.
    - Microchip Technology Inc.
    - Mitsubishi Electric Corporation
    - Topcon Corporation
    - Yokogawa Electric Corp

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

    - **ABB Ltd**
    - **Rockwell Automation**
    - Schneider Electric S.A.
    - Siemens

Applications - highlights all index companies that incorporate multiple robotic and automation technologies into their product or manufacturing process to improve efficiency in traditional business lines as well as the development of entirely new business propositions:

6. **Manufacturing & Industrial Automation** - Broadly speaking, this is the main way in which companies take raw materials through a manufacturing process to create products. It is also the earliest successful application for robotics and automation – for example, automobile assembly - and continues to be one of its largest growth areas.

    - Aida Engineering, Ltd.
    - ATS Automation Tooling Systems Inc.
    - Brooks Automation, Inc.
    - DAIHEN Corporation
    - Denso Corp.
    - **Fanuc Corporation**

- **Krones AG**
- **KUKA AG**
- Nachi-Fujikoshi Corp.
- Nordson Corporation
- Teradyne
- Toshiba Machine Co. Ltd.
- **Yaskawa Electric Corp.**
- **Yushin Precision Equipment Co., Ltd.**

7. **3D Printing** - Traditionally, things are built either by assembling separate parts, or by removing material from a larger work-piece. 3D printing, also called additive manufacturing, adds yet another capability by depositing different types of materials where they are needed. One of its main benefits is the potential for customization that is not economically feasible with traditional techniques.

    - 3D Systems Corp
    - Arcam AB
    - SLM Solutions
    - Statasys Ltd.

8. **Logistics Automation** - The manufacturing of items is incomplete without the material handling and distribution channels that bring the objects to their intended users. The many economic advantages to speedy and error-free distribution, such as operating with low-inventory and being responsive to customer demands, is a significant growth area for robotics and automation, and is continually reducing the costs for end-users, both businesses and consumers.

    - Cargotec Corp
    - Daifuku
    - John Bean Technologies
    - Kardex AG
    - SFA Engineering Corporation

9. **Agriculture** - Feeding and sustaining the world continues to be one of our most important economic activities. A new generation of autonomous systems is bringing precision and the elimination of rote labor to this domain. For example, precision agriculture offers to greatly reduce costs and our environmental footprint by applying water and fertilizer on an as-needed basis.

    - Deere & Co

10. **Security** - Removing people from harm's way has always been a main driver for robotics research. Up until recently, it has been difficult for machines to duplicate a human's flexibility and cognitive skills. However, with today's technologies, unmanned aircraft and ground vehicles are now capable of detecting hazardous materials, disposing of bombs, operating in space and performing critical national defense functions (surveillance).

    - **Aerovironment, Inc**
    - Elbit Systems
    - Macdonald Dettwiler & Associates
    - Northrop Grumann Corp

11. **Energy** - Exploration, extraction, and maintaining the energy infrastructure require extensive and growing resources. Robotics and automation continues to expand from structured environments, such as warehouses and factories, to unstructured ones, such as outdoors, underground, and underwater. The energy sector will reap the rewards of this transition with lower operational costs.

    - FMC Technologies
    - Helix Energy Solutions
    - Kongsberg Gruppen ASA
    - **Oceaneering International**

12. **Healthcare** – As global healthcare costs continue to rise, robotics and automation is poised to provide a countering force to this trend. Through rehabilitation, diagnostics, exoskeletons and elderly care, using robotics and autonomous systems promises to drastically reduce costs, while improving quality of life. In addition, robotics and automation can transcend cost-cutting by using of robots for difficult surgeries and neurological treatments that were previously unfeasible.

    - **Accuray Incorporated**
    - **CYBERDYNE Inc.**
    - Elekta AB
    - **Intuitive Surgical, Inc.**
    - Mazor Robotics Ltd.
    - Qiagen NV
    - ReWalk Robotics Ltd.
    - Tecan Group Ltd.
    - TransEnterix
    - Varian Medical Systems, Inc.

13. **Consumer Products** – From interactive robots for entertainment to automating household chores, consumer companies work to make everyday lives easier and more enjoyable. The Internet of Things promises to usher in a new era of interconnectivity. By communicating through the existing internet infrastructure, devices will no longer be isolated islands of limited capabilities. This impact will be particularly pronounced for these types of consumer products, which need to be inexpensive for wide adoption. Through the internet, robotics and automation will finally become broadly affordable to individuals.

    - **iRobot Corp**
    - Parrot SA