Fallbrook Technologies Inc.

Company Information

Company Fact Sheet

Year Founded
1998. Became Fallbrook Technologies Inc. in 2004.

Business
Fallbrook Technologies Inc. (Fallbrook) is a manufacturing and technology development company dedicated to improving mechanical transmission-based products. The Company's core technology is its NuVinci® continuously variable planetary (CVP). The award-winning technology has been recognized as revolutionary and is potentially applicable to any product that uses a transmission including bicycles, light electric vehicles, agricultural equipment, automobiles, and wind turbines among others. Fallbrook manufactures and markets *NuVinci* drivetrains for the bicycle market. In addition, it partners with other companies to commercialize its *NuVinci* technology and provides design, development and manufacturing support.

Fallbrook currently holds over 700 patents and pending applications worldwide.

NuVinci® Technology
Fallbrook's *NuVinci* technology is a scalable and highly adaptable CVP technology that controls relationships of speed and torque. The *NuVinci* transmission uses a set of rotating and tilting balls between the input and output components of a transmission. Tilting the balls changes their contact diameters and varies the speed ratio. Compared to other current continuously variable transmission technologies, *NuVinci* technology is less complex, scales and packages more easily, costs less to manufacture and improves performance.

Current Markets

- Automotive-class applications
  - Primary transmissions
  - Variable speed accessory drives
- Electric vehicles (including low speed / urban vehicles)
- Bicycles and eBikes
- Stationary and off-road equipment
- Agricultural equipment
- Wind energy

Ownership
The Company is privately funded and privately held. Equity funding raised to date: $115 million. Major stockholders are Macquarie, NGEN, Robeco, and Allison Transmission.

Executive Management

- William G. Klehm III, Chairman and CEO
- Robin Grey, CFO
- Sharon A. O'Leary, Chief Legal Officer, Secretary and VP of Human Resources
- David Hancock, Executive Vice President, Cycling Division
- Jeremy Carter, Vice President of Product Development
- Brian Crum, Vice President of Operations

Headquarters

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Cedar Park, TX 76813
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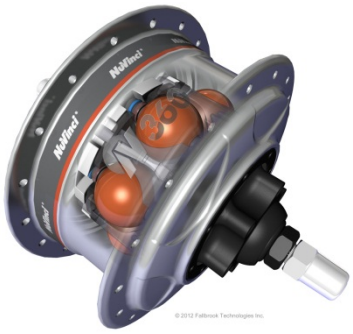
Company Overview

Originally established in 1998 and incorporated in 2004, Fallbrook Technologies Inc. (Fallbrook) is a manufacturing and technology development company dedicated to improving mechanical power transmission products.

Headquartered in Cedar Park, Texas, with operations in Europe and China, Fallbrook's patented and award-winning NuVinci® technology has far-reaching implications. The Company's *NuVinci* continuously variable planetary (CVP) technology is potentially applicable to any product that uses a transmission, including bicycles, electric vehicles, accessory drives, agricultural equipment, and wind turbines, among others.

The *NuVinci* CVP provides the most adaptable and scalable continuously variable transmission (CVT) available today for companies that need a cost effective, easily controlled, and durable alternative to conventional transmissions or other CVTs. The *NuVinci* CVP improves acceleration, performance, cost and overall vehicle efficiency over conventional transmissions. Compared to other CVTs, it is far simpler, offers more stable control, permits more scalability across product lines, is easier to package in a vehicle, and is less expensive to manufacture and assemble.



The *NuVinci* transmission uses a set of rotating and tilting balls in elastohydrodynamic contact between the input and output components of a transmission that tilt to vary the speed of the transmission. Tilting the balls changes their contact diameters and varies the speed ratio.

Current commercial products are the NuVinci® N360™ bicycle transmission, the NuVinci® Harmony™ auto-shifting system for e-Bikes and the Hodyon Dynasys™ auxiliary power unit. Other products utilizing *NuVinci* technology are in various stages of development.

The Company currently has over 500 patents and patent applications worldwide.

The Company is privately funded with over $115 million raised; Macquarie, NGEN, Robeco and Allison Transmission are major stock holders.

Company History

The story of Fallbrook and its *NuVinci* technology dates, in a sense, to the year 1490, when Leonardo da Vinci developed a drawing describing how a continuously variable transmission (CVT) might work. Over 450 years later, the first real-world models of CVTs for automobiles were produced, but a variety of problems (e.g., cost, scalability, size, packaging difficulty, durability, and weight) has kept CVTs from widespread adoption and has limited their practical application.

The Quest for the World's Fastest Bike
Donald C. Miller, a cycling enthusiast, was interested in building the world's fastest bike. In analyzing the challenges involved, he quickly found that the transmission was a limiting factor. While looking around for new ideas, Don came across CVTs. His subsequent experiments led him to develop an entirely new concept for CVT-based bicycle transmissions.

Miller and a group of investors formed Motion Systems, Inc. (MSI) to develop the technology. By 2000, Don had developed a design that fully addressed all the traditional weaknesses of a CVT, and had applied for the first patents covering the technology.

The Company Takes Shape
As part of a process to provide additional funding and guidance, Miller and The Weiss Group LLC, an investment and startup advisory firm, joined forces in 2000 to form Motion Technologies LLC (Motion Technologies). Motion Technologies acquired MSI's intellectual property and development rights, with Don serving as the initial CEO.

A second round of financing in 2003 for Motion Technologies via a private placement provided funds for the continued development of the technology. Tests on Don's transmission by a prestigious independent testing laboratory, quickly verified the potential of the revolutionary technology – providing significant gains in simplicity and durability. The testing also showed that the technology had potential applications far beyond just bicycles – to virtually any device that has a transmission. Robert Smithson, a transmission expert involved with the testing laboratory's preliminary assessment, was so impressed with what he saw that he joined the Company, first as a consultant and later as vice president of product development and subsequently served as the Company's Chief Technology Officer.

Testing Proves the Potential
As development progressed, it soon became apparent that the technology's potential was even greater than originally anticipated. Smithson discovered that the technology would also support the implementation of an infinitely variable transmission (IVT). Additionally, Fallbrook identified potential applications in the area of wind energy. At that point, management determined that further funding and additional executive talent would be appropriate.

Motion Technologies LLC became Fallbrook Technologies Inc., in 2004, and in May of that year, auto industry veteran Bill Klehm became Fallbrook's president and CEO. Don Miller then became vice president of advanced research. The Company immediately began an aggressive funding effort and also accelerated research and development. Fallbrook obtained additional funding via a private placement and assembled a staff that includes many top engineers in the transmission field. The technology was given the name *NuVinci* CVP (Continuously Variable Planetary), in honor of its 500-year-old predecessor. The accelerated R&D effort began producing tangible results in 2004, when the Company signed its first agreements with manufacturers.

In 2005, the Company signed a manufacturing license agreement with Aftermarket Technology Corp. (ATC) (NASDAQ: ATAC).

Fallbrook entered into a trademark licensing and development agreement with the Valvoline division of Ashland Inc. in 2006, enabling Valvoline to design, test and market specialty fluids that optimize the performance of the *NuVinci* CVP. Also during 2006, Fallbrook entered into OEM licensing agreements to design and market bikes and electric scooters featuring the *NuVinci* drivetrain.

Production Begins
NuVinci CVP bicycle hubs (model N170S) began rolling off ATC's assembly line in Oklahoma City, Oklahoma in December 2006, marking the first shipment of commercial products based on *NuVinci* technology.

The Adagio-*NuVinci* bike manufactured by Batavus BV won the 2007 Bike of the Year award at the FietsVak bicycle show in the Netherlands. At the same show, the *NuVinci* drivetrain won the Innovation of the Year award. The *NuVinci* CVP also was selected for the prestigious 2007 R&D 100 Awards as one of the most important new technologies of the year. And in November of 2007, the *NuVinci*-equipped The Ride™ Performance Lifestyle bike by Ellsworth was honored by Popular Science magazine with the Grand Award for the year's "Best of What's New" recreational product. In 2008 the next generation N171 added another highly-regarded award to its growing list of accolades, an iF Design / Eurobike Gold Award.

Focus on Wind Energy
In 2007, Fallbrook created a wholly-owned subsidiary called Viryd Technologies Inc. to develop and produce *NuVinci* products for the wind energy market – specifically, so-called "small wind" products designed for homes and small businesses. In 2009, Viryd was spun off as a standalone company with a license for *NuVinci* technology from Fallbrook.

Manufacturing Moves In-House
In February 2008, Fallbrook announced that it would manufacture its *NuVinci* hubs for the bicycle and light electric vehicle markets, while continuing to license the technology to manufacturers in other markets. Fallbrook selected MTD Products Inc. (MTD) as the prime supplier for its manufacturing efforts.

Also in February 2008, the Company executed an agreement with ATC for the purchase of ATC's business assets associated with its *NuVinci*-related manufacturing in order to provide for a single source of *NuVinci* products in the marketplace.

The N360™ -- next generation *NuVinci* Bicycle transmission.
In 2009, the Company began to phase out production of the *NuVinci* N171 bicycle transmission (the model produced by MTD) in preparation for the introduction of a next generation model, the NuVinci® N360™. The *N360* model was designed to have many improvements over the N170/N171 models including an over 30% reduction in weight, a diameter over 15% smaller, and an increased ratio range, together with an improved shift feel and responsiveness and a lower cost.

The Company terminated its manufacturing agreement with MTD and selected Tri Star Group, located in Shanghai, China, to manufacture the *N360*. Production of prototypes began in December 2009 and manufacturing of the *N360* launched in June 2010 with initial

customer shipments in July 2010. The *N360* model subsequently won a 2010 iF/Eurobike award, which was the second iF/Eurobike award for the *NuVinci* CVP for bicycles.

Entry into Automotive Market with NuVinci® DeltaSeries™
In September 2010, The Company announced its entry into the transportation market with its *NuVinci* DeltaSeries™ accessory drive and primary transmission technology which promises to increase both fuel efficiency and vehicle performance. The Company has subsequently obtained and is obtaining additional independent validations of *NuVinci* value propositions for the automotive market.

Acquisition of Hodyon L.P.
On March 7, 2011, the Company announced the business acquisition of Hodyon LP, a manufacturer and distributor of energy-efficient products and systems. Hodyon's primary product focus is its diesel-electric Dynasys™ Auxiliary Power Unit (APU) system. Hodyon operates as a wholly owned subsidiary and will incorporate Fallbrook's patented *NuVinci* continuously variable planetary (CVP) transmission to create a more efficient, next generation APU product.

Joint Venture with Ningbo Shentong Group
On March 14, 2011, the Company and Ningbo Shentong Group (Shentong), a Tier 1 automotive supplier to the Chinese automotive industry, announced an agreement for the establishment of a joint venture to develop and market Fallbrook's NuVinci® continuously variable planetary (CVP) transmission technology for electric-powered passenger cars and light trucks in China and abroad.

Introduction of Harmony® Auto-Shifting System for Bicycles
In August of 2011, the Company introduced the world's first automatic CVP shifting system for bicycles. The *NuVinci Harmony* intelligent drivetrain is an innovative and intuitive shifting system that leverages the unique benefits of the Company's award-winning *NuVinci* N360™ and is designed specifically for the fast-growing and advancing e-Bike market in Europe and North America. A new era of cycling experience begins with *NuVinci Harmony!*

Allison Transmission and Dana Holding Corp. License the Rights to NuVinci® Technology
On September 13, 2012, Allison Transmission, Dana Holding Corp. and Fallbrook announced strategic licensing relationships with the Company and plans to cooperate on engineering and manufacturing of next generation transmissions**.**

Doing Business with Fallbrook

Fallbrook's mission is to develop, in conjunction with its partners, the best performing, most versatile and most reliable mechanical power transmissions in the world. To achieve this, Fallbrook's partnering program is designed to work with companies known for industry leading expertise and to create a community of technology around the *NuVinci* CVP. By sharing technology, implementation techniques and innovations, Fallbrook and it partners will ultimately speed the adoption and expansion of *NuVinci* technology to:

- Enhance vehicle performance and the user experience
- Enable new functionality for existing and first-time applications

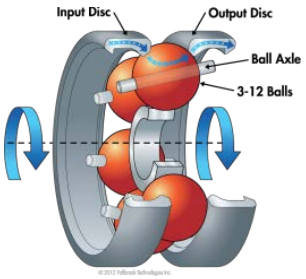
- Improve fuel economy and/or energy consumption in the operation of the end product
- Provide a sustainable competitive advantage

Fallbrook has *partnerships* with *Manufacturers*, companies who manufacture *NuVinci* CVPs and/or parts, and with *Original Equipment Manufacturers (*OEMs), companies who integrate the *NuVinci* CVPs into products or vehicles that are then ultimately sold to consumers.

Fallbrook also offers engineering services to its partners. Through its engineering services, Fallbrook is able to help its partners develop new *NuVinci* CVPs that are specifically designed and optimized for the partner's unique applications and the requirements of those applications.

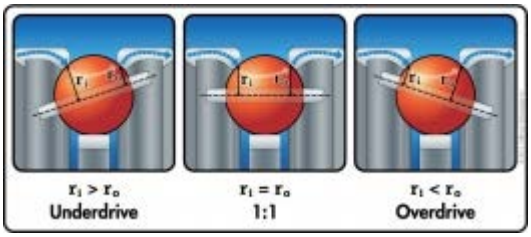
Technology Overview

The patented NuVinci® technology developed by Fallbrook Technologies Inc. (Fallbrook) is the most practical, economical and universally adaptable continuously variable transmission (CVT) for human-powered and motor-powered vehicles and machines. Because it is functionally analogous to planetary gear sets, the *NuVinci* technology defines a new species of CVT, the continuously variable planetary (CVP) drive. The *NuVinci* CVP is ideally suited for applications in many major industries including bicycles, light electric vehicles, automobiles, tractors, trucks, and wind turbines among others.



The *NuVinci* transmission uses a set of rotating and tilting balls positioned between the input and output components of a transmission that tilt to vary the speed of the transmission.

Tilting the balls changes their contact diameters and varies the speed ratio. As a result, the *NuVinci* CVP offers seamless and continuous transition to any ratio within its range, thus maximizing overall powertrain efficiency, with no jarring or shocks from the shifting process, and improving acceleration, performance and overall vehicle efficiency over conventional transmissions. When compared to traditional CVTs, the *NuVinci* CVP is less complex, has considerably fewer parts, offers more stable control and scalability across product lines, is better packaged, and is less expensive to manufacture and assemble.



Distinguishing the *NuVinci* CVP from Traditional CVTs

There is a clear distinction between Fallbrook's *NuVinci* CVP drive and more traditional CVT technologies.

A CVT is a transmission that is infinitely variable between its high and low ranges, unlike a conventional geared transmission where the number of fixed *speed ratios* between high and low is limited by the number of *gears*.

The CVT has been called the "holy grail" of transmissions because it eliminates the multiple gears, shifting clutch(es), and many other parts found in conventional transmissions. In place of gears, most CVTs use one or more cones, discs, balls, belts, toroids, or other shaped devices for gradually changing ratios. These geometric shapes

allow the input or output contact points on any particular device to vary in diameter, thus changing the input to output speed.

The use of CVTs has not become widespread due to multiple problems inherent in conventional designs. These problems include shifting control difficulties, packaging problems, scalability challenges, questionable reliability and durability, high cost, increased weight, and other factors.

The *NuVinci* CVP represents a quantum leap forward from other CVTs as well as conventional mechanical transmissions. These advantages include:

- Higher torque density
- Smaller size/weight
- Easily scalable
- Simpler, more elegant design
- More adaptable and versatile
- Improved overall performance
- Greater system efficiency
- Easy to package (less space required)
- Lower manufacturing and maintenance costs

The *NuVinci* Transmission

The *NuVinci* CVP is continuously variable and infinitely applicable to almost any product using a mechanical power transmission. *NuVinci* technology combines the advantages of a toroidal traction CVT with the time-proven versatility of the planetary gear arrangement. It uses rolling traction to transfer torque, just as do toroidal transmissions. However, unlike toroidal CVTs, it distributes the transmitted torque over several spheres in an inherently stable configuration, thus lowering total clamping force required and significantly improving durability, control stability, and torque density.

This arrangement makes the *NuVinci* CVP the only practical CVT to combine the smooth, continuous power transfer of a CVT with the utility of a conventional planetary gear drive. Torque inputs can be summed or divided, just as in a conventional planetary. Ratio control is stable, and can be actuated down the center line of the transmission, which again is similar to the proven planetary transmission. Part shapes are simple and relatively easy to manufacture, and in most applications, there is no need for power-robbing, high-pressure hydraulics.

The *NuVinci* CVP reduces energy consumption through its continuous speed changing characteristics, allowing the power input prime mover (such as a gasoline engine or electric motor) to operate in its most efficient speed range. Overall, the *NuVinci* CVP's mechanical and manufacturing characteristics improve performance and reliability while reducing costs over conventional CVTs and stepped transmissions. As a result, the *NuVinci* CVP can potentially replace the planetary gear transmission in most mechanical devices.

Key advantages of the *NuVinci* CVP

Compared to conventional transmission technologies, the *NuVinci* CVP provides:

- **Less complexity.** There are significantly fewer parts than conventional transmissions and it is potentially much less costly to manufacture.

- **Overall improved system efficiency.** With the *NuVinci* CVP, it is easy to keep an engine or motor running at its most efficient speed.
- **Greater acceleration and optimum performance.** Acceleration is faster and smoother – right up to the vehicle's acceleration limits - because it keeps the engine running at peak performance.
- **Easier shifting.** There is no jarring associated with shifting gears.
- **Ability to accept multiple inputs while varying speed and ratio, managing torque and providing single or multiple power outlets.** A *NuVinci* CVP is the most practical CVT technology to perform all of these tasks simultaneously.
- **Support for a torque demand rather than a speed demand control solution.** The *NuVinci* CVP solves the low-speed acceleration problem inherent in some torque-demand vehicles.
- **Scalability and potential to reuse tooling.** The *NuVinci* technology is highly scalable. The design and implementation of a low-torque application utilizing four balls may involve the same basic parts as a higher torque application with eight or sixteen balls. Also, tooling can be used across a wide variety of applications.
- **Improved hill-climbing.** The *NuVinci* CVP allows a driver to drive up a hill at the desired speed and in the proper transmission ratio without having to choose, as with traditional geared transmissions, between a gear that is too high and bogs the engine down resulting in a lower speed or a gear that is too low and results in an over revving engine speed.

Compared to CVT alternatives, the *NuVinci* CVP offers:

- **Coaxial input and output.** The input and output shafts may be either in-line, offset, or in a U configuration (input and output both coaxial and coplanar), making the transmission simpler, smaller, lighter, and easier to package
- **Better torque density.** A *NuVinci* CVP delivers a large amount of torque capacity in a relatively small space. It is smaller and easier to package than other CVTs because it does not require an offset shaft and because it can spread torque across any number of traction contacts by using many balls.
- **Lower manufacturing cost.** The transmission uses simple geometry and very simple parts, which results in a lower cost. The *NuVinci* CVP can also be scaled across a wide variety of vehicles, in many cases without significant retooling.
- **Lower control cost.** Transmission control is stable, linear and does not require a major control system development effort.
- **Power path variability.** The technology is easily integrated into a wide range of applications with varying power path requirements or options
- **Scalability.** The *NuVinci* CVP's simple design and low part count make it easily scalable.

Technology Applications for *NuVinci* technology

While the *NuVinci* CVP has application potential in virtually any mechanical device requiring speed changes, Fallbrook has selected five major target markets for its initial development of *NuVinci* technology:

- Bicycles
- Electric Vehicles
- Continuously variable vehicle accessory drives (DeltaSeries™)
- Lawn & Garden
- Wind Energy

Fallbrook selected these initial markets because they offer:

- High potential for early adoption by manufacturers
- Large market size
- Short time to market
- Companies seeking a competitive advantage through improved technology

Awards & Honors

NuVinci® CVP technology has been recognized as a game-changer by numerous organizations worldwide. Some of the awards and recognition *NuVinci* has garnered include:

2012 North American Frost & Sullivan Growth Capital Investment Opportunity Award in the Powertrain Market

Frost & Sullivan stated:

> "The company exhibits all the features of a superior market participant that deserves close attention from investors looking for opportunities." Click here for more about this prestigious award."

NuVinci® Drivetrain

NuVinci® Bikes

For additional information on awards that Fallbrook has received, go to www.fallbrooktech.com/nuvinci-technology/awards-honors.

NuVinci® Model N360™ CVP

Released in 2010, the *NuVinci N360* CVP is a major enhancement of the *NuVinci* bicycle drivetrain.

As with previous *NuVinci* hubs, the *N360* uses spheres instead of gears to transfer torque, but the number of spheres has been reduced from eight to six.

The *N360* is 30% lighter, weighing just 2.45 kg (5.4 lbs.), and has a 17% smaller overall diameter than previous *NuVinci* models. Shift effort is significantly reduced, even under high pedal forces.

The *N360* also provides an enhanced shifting interface. There is a more direct feel for the rider, with 50% less shift grip rotation required between the lowest and highest ratios. Shift effort under pedal torque is also less, so riders can shift at any time, in practically any condition. The redesigned shifter display now includes the icon of a rider on its unique “inchworm” indicator. Additionally, the new hub interface is inside rather than outside of the frame dropout, which reduces the likelihood of damage in the event of a fall.

These changes dramatically widen the range of bike models that can now benefit from the smooth, seamless-shifting *NuVinci* drivetrain. These model types include Trekking, Sportive and Flat Bar Road bikes, as well as Urban, Commuter, Folding, Hybrid, Cruiser, and e-Bikes.

Technical Data

Hub Colors:	Silver or Black
Spoke Configurations:	32 or 36 Hole
Brake Configurations:	Disc, Rim, or Roller
CVP Weight:	2,450 grams
Speed Ratio:	Infinitely variable within ratio range
Ratio Range:	360% Nominal (0.5 Underdrive to 1.8 Overdrive)
Shifting:	Variable twist grip, ¾ Turn
Drop-out:	135 mm Wide, Horizontal or Vertical
Chainline:	49.0 ± 0.5 mm (also compatible with belt drives)
Sprockets:	Standard 9-spline (not included); 17 - 22 tooth supported
Sprocket Ratio:	1.8:1 Minimum (17/31, 18/33, 19/35, 20/36, 21/38, 22/40, larger chain rings can be used without exception)
Corrosion Resistance:	ISO 9227, Neutral Salt Spray, 384 hours

NuVinci® Harmony™ Auto-Shifting Drivetrain

In August of 2011, Fallbrook introduced the first automatic CVP shifting system for bicycles. The *NuVinci Harmony* intelligent drivetrain is an innovative and intuitive auto-shifting system that leverages the unique benefits of the Company's award-winning *NuVinci* N360™ to deliver a smooth, enjoyable ride experience like no other. It offers the rider the option to seamlessly shift automatically or manually without any limiting or jarring gear steps typical of conventional bicycle drivetrains.

Harmony is designed specifically for the fast-growing and advancing e-Bike market in Europe and North America. E-Bike manufacturers now have the ability to offer their customers exactly what they want – a smooth and organic interaction between rider and bicycle that works automatically and seamlessly with the *NuVinci N360* drivetrain. It is for this unique ride experience that the system is appropriately named… *Harmony*.

Harmony advantages:

Smart	The weather-sealed system monitors pedal cadence and bicycle speed, then auto-adjusts the drive ratio to maintain the rider's preferred pedal cadence.
Simple	The primary connector quickly and easily disconnects for rear wheel removal easier than any other manual cable shifting system. Optional twist or push-button controllers make setting desired pedal cadence simple and precise.
Smooth	The *Harmony* system is compatible with 12–48 volt e-Bike systems, and all shifting mechanics and logic reside inside the compact *Harmony* hub interface at the CVP.

Harmony Base Controller

For riders who do not like shifting or for those who just prefer simplicity, the *Harmony* Base Controller intelligently manages the ride by automatically maintaining the pedaling cadence the rider chooses. With its three-button automatic-only shifting, things are kept very simple: press a button and enjoy the ride! The cadence settings (typically slow – medium – fast) can be preset by the e-Bike manufacturer. With the Base Controller, the rider need never think about shifting again.

Harmony Advanced Controller

The *Harmony* Advanced Controller offers both fully automatic and manual shifting options in one drivetrain. In "Automatic" mode, *Harmony* automatically and continuously adjusts the drive ratio to maintain the rider's preferred cadence. The Advanced Controller allows the rider to select and fine-tune their cadence set-point by twisting the shifter. *Harmony* will automatically and seamlessly maintain whatever cadence

the rider selects. For manual operation, simply press the Advanced Controller “mode” button and the display will switch to an orange “hill” indicator. In this mode, the rider is able to directly control the *NuVinci* CVP ratio manually.

General Features and Specifications

- Compatible with 12 – 48VDC e-Bike systems
- 360º ratio range: 0.5 underdrive to 1.8 overdrive
- *Harmony* Hub Interface weight: less than 250g
- Weather-sealed system with quick-release primary connector
- Advanced Controller: dual mode, variable twist grip, ½ turn full rotation
- Base Controller: 3-button, preset auto-only modes
- Availability: at dealers early 2012
- Warranty: two years
- Manufactured in Taiwan
- Price: Expect to see *Harmony* on e-Bikes with retail pricing starting at the 2,000 Euro range

NuVinci® - Continuously Variable Accessory Drives

A continuously variable accessory drive (CVAD) is a device that helps the front-end accessories on a car or truck engine (alternator, air conditioner, water pump, etc.) run more efficiently. These belt-driven accessories have always been connected directly to the engine, so their speeds are tied to engine RPM. A CVAD sits between the engine and these accessories, allowing their speed to vary according to performance needs rather than engine RPM.

The *NuVinci* accessory drive line is a power management system that offers seamless and continuous transition to any ratio within its range, thus maximizing overall powertrain efficiency. A *NuVinci*-based accessory drive produces more torque at low input speeds, providing improved performance for belt-driven accessories. It improves fuel economy by decoupling accessory speed from engine speed. In addition, *NuVinci* technology is quiet, smooth, compact, and easy to package.

The *NuVinci* CVP has several current and potential areas for accessory drives, including:

- **Air conditioning compressor:** improves AC compressor performance by decoupling the engine speed from the compressor speed, enabling the compressor to operate in its optimal range based on demand regardless of engine speed.
- **Alternator-mounted:** extracting additional power from the alternator to increase power at idle without overspeeding the alternator, or even slowing it down for fuel conservation, at higher speeds
- **Crankshaft-mounted:** optimizing the performance of belt-driven engine accessories to improve fuel economy
- **Supercharger:** providing significant boost at low RPM by enabling high turbine speeds at low engine speeds

Air condition compressor:

A *NuVinci* AC compressor accessory drive improves AC compressor performance by decoupling the engine speed from the compressor speed, enabling the compressor to operate in its optimal range based on demand regardless of engine speed. As a result, the *NuVinci* compressor accessory drive delivers the ideal compressor speed all the time – optimizing AC operation and performance, thereby enhancing performance, increasing system efficiency and improving fuel economy. Other benefits include:

- Increased compressor output at low engine speeds
- Reduced compressor speed during cruise improves fuel economy
- Flexible packaging
- Opportunity to rightsize AC compressors
- Reduce startup torque transients to clutch, compressor, accessory beltline, thereby reducing noise, vibration, and harshness (NVH)
- Optimized, demand-based compressor performance during cruise and acceleration

Alternator-Mounted

A *NuVinci* accessory drive improves alternator performance by decoupling engine speed from alternator speed, enabling the alternator to produce maximum current regardless of engine RPM. As a result, *NuVinci* technology:

- Increases power at idle
- Increases capacity of front-end accessories
- Enables downsizing of accessory capacity
- Reduces engine startup torque requirements
- Improves battery life

Crankshaft-Mounted

A crankshaft-mounted *NuVinci* accessory drive decouples belt-driven accessories from engine speed, enabling them to run at the minimum speed required to meet accessory load. At higher engine RPM, decreasing accessory speeds decreases power, thus saving energy. Additional energy savings can be realized by optimizing the accessories for a narrow speed range operation. Conversely, at low engine RPM, the accessory belt speed can be increased to provide additional battery-charging power or to increase the water pump speed. Thus, the *NuVinci*-equipped crankshaft accessory drive:

- Improves fuel economy
- Improves acceleration by under-driving the accessories to a greater degree than would be practical with fixed ratio pulleys
- Provides smooth accommodation of engine/load transients
- Creates opportunities to add “smart” controls for accessory drives
- Enables downsizing of accessory capacity

Supercharger

The *NuVinci* supercharger drive is a power management system for engine accessories that enables significantly more boost at low RPM by enabling high supercharger speeds at low engine speeds, providing increased torque for launch and towing. The *NuVinci* CVP does this by offering an infinite number of speed ratios between its high and low ratio extremes, with programmable instantaneous, smooth and continuous ratio changes. Operation is completely seamless and transparent to the driver. The *NuVinci*-equipped supercharger accessory drive enables:

- Supercharger speed control independent from engine speed
- More boost, providing higher performance, especially at lower engine speeds
- Engine downsizing without sacrificing performance:
  - Improved fuel economy
  - Reduced operating costs of heavy-duty fleets
- Diesel-like performance from gasoline engines

NuVinci® – Powering Electric Vehicles

Today's electric vehicles (EVs), for the most part, do not use multi-speed transmissions. That means every time a driver starts from rest, climbs a hill or carries a heavy load in an EV, they're reducing the amount of energy that they can get out of the batteries because in driving conditions like these, high flow rates of electrical current are required from the battery, which causes the battery charge to run down faster. Simple logic dictates that someone might want to do something to reduce the amount of time that the EV powertrain spends drawing a lot of amps so that they could maximize what they get to use versus what you put into the battery – something that could get them up to speed faster, or reduce the amps required to climb a hill, for example.

EV's traditionally have not used multi-speed, "clutch and gear" transmissions for a number of reasons, chiefly among them:

- Conventional multi-speed transmissions do not work well with electric powertrains because the abrupt steps between gears cause problems with durability and driving comfort.
- Conventional transmissions suffer from gear noise, which when an internal combustion (IC) engine is present, is drowned out by the engine noise. That background soundtrack is not present in an EV. Smaller, lighter, and more optimized vehicles cannot hide the excessive noise like a larger vehicle with an IC engine can.
- EV designers were driven by high electronics and battery costs to minimize the cost of the rest of the powertrain, and an electric motor's inherent high torque at zero speed allows the design crutch of eliminating the transmission, at the expense of higher amp draws and a single compromised overall final gear ratio.

  The present single speed transmission forces the designer of the EV to select a much bigger VFD (Variable Frequency Drive) because of the higher current requirement. Consequently the cabling must be adequate in size to handle the larger VFD's output (the larger wire size is heavier, more expensive, and harder to package because it does not bend as readily as smaller cables do). With a continuously variable accessory drive a smaller motor-controller system with lighter harness can produce the same performance of the single speed transmission that uses a larger motor-controller.

This is where Fallbrook Technologies comes in with its *NuVinci* continuously variable planetary (CVP) system. The technology solves the issues of abrupt steps by smoothly and continuously varying speed ratio while also operating very quietly and, at the same time, increasing torque multiplication at low speed.

- The *NuVinci* CVP's ability to change torque multiplication on the fly provides the following advantages to the EV designer:
  - Amp draw in a start from rest is reduced in both amplitude and duration because the extra torque available from the motor/CVT combination accelerates the vehicle faster with less load on the motor. As a result, a smaller copper cable is needed to connect the motor terminals to the motor controller.

- A smaller motor can often be fitted while maintaining the same or improved acceleration performance, again because of the ability to change torque multiplication on the fly. The smaller motor draws fewer amps to get the job done, and requires less in the way of power electronics.

With the smaller amp draws, a smaller battery pack can now be fitted, which results in extra benefits from reduced pack weight (a large fraction of an EV's weight lies in its batteries), and reduced pack size. Taking out weight improves EV performance in every dimension.

Frequently Asked Questions

Q: What is Fallbrook Technologies Inc.?

A: Fallbrook Technologies Inc. (Fallbrook) is a manufacturing and technology development company headquartered in Cedar Park, outside of Austin, Texas. The Company also has operations in Europe and China.

The Company's core technology is its traction-based, NuVinci® transmission – a continuously variable planetary (CVP) drivetrain ideally suited for applications in virtually any mechanical device that has a transmission or requires speed variation.

Q: What is the NuVinci® CVP?

A: The *NuVinci* CVP is a continuously variable and broadly applicable technology, with applications for almost any product using mechanical power transmission. *NuVinci* technology combines the advantages of the inherently smooth and quiet traction continuously variable transmission (CVT) with the advantages of a time-proven planetary gear arrangement. The *NuVinci* CVP is the only continuously variable transmission that has a planetary gearset's advantages of high torque density, versatility of use, inline shafts, capability to sum and divide torque from one or multiple input devices, and low production cost. As a result, *NuVinci* technology is the only technology potentially capable of replacing the planetary gear transmission – in every application – as virtually a plug-and-play, yet vastly more capable, replacement.

Q: How does the *NuVinci* CVP work?

A: The *NuVinci* transmission uses a set of rotating balls between the input and output components of a transmission that tilt and vary the output speed of the transmission. Tilting the balls changes their contact diameters with the discs, which varies speed. As a result, the *NuVinci* CVP improves acceleration, performance and powertrain efficiency over conventional transmissions. It is far simpler, permits more stable control, provides more scalability across product lines, is better packaged, and is less expensive to manufacture and assemble than traditional CVTs.

Q: Why is the technology named *NuVinci?*

A: The name represents a "tip of the hat" to Leonardo da Vinci who, over 500 years ago, sketched what is considered to be the first documented continuously variable transmission.

Q: CVTs have been around for a long time. Why have they not become commonplace?

A: The use of CVTs has not become widespread due to multiple problems including scalability challenges, questionable reliability and durability, high cost, and other factors. Despite some obvious drawbacks, some manufacturers such as Ford, Nissan, Honda, and Audi have implemented limited production with old CVT technology because the market need was so great. However, with the development of the *NuVinci* CVP, the technical roadblocks have now been eliminated – clearing the way for a wide range of CVP applications for which markets are ready and waiting.

Q: How is the *NuVinci* CVP different from conventional transmissions?

A: The *NuVinci* CVP offers a wide range of advantages over conventional transmissions. These advantages include:

- Less complexity
- Greater powertrain system efficiency
- Greater acceleration and optimum performance
- Easier shifting
- Ability to accept multiple inputs while varying speed and managing torque
- Multiple power outlets such as for a power take off (PTO) application
- Easier to package and potentially lighter
- Easier and less costly to manufacture
- Greater scalability and potential to reuse tooling
- Improved hill-climbing

Q: How is a *NuVinci* CVP different from other approaches to CVT technology?

A: There are four widely accepted alternative approaches to CVT technology:

- **Toroidal.** The *NuVinci* CVP, comparatively offers better torque capacity in the same package volume and simpler control, and is more easily packaged for inclusion in a given application due to its concentric input and output shafts. It is also much more effective to scale across a vehicle range because of its modular nature and is more durable because of its greater number of traction contacts.
- **Push Belt.** The *NuVinci* CVP is simpler in design, more scalable, easier to control, allows for inline shafts and is less expensive to manufacture. It also does not have the ultimate torque capacity limitations of the push belt and is expected to be more durable.
- **Hydromechanical.** The *NuVinci* CVP is much easier to manufacture, easier to control, lighter, more scalable, inherently quieter, and easier to maintain.
- **Chain.** The *NuVinci* CVP has greater torque capacity, allows for inline shafts, and is easier to control, more scalable, inherently quieter, and less expensive to manufacture and maintain.

Q: What markets have the greatest potential for *NuVinci* technology?

A: While the *NuVinci* CVP has application potential in virtually any mechanical product that has a transmission, Fallbrook has identified five initial major industries for the *NuVinci* technology:

- Bicycles
- Electric vehicles
- Continuously variable vehicle accessory drives
- Lawn & Garden
- Wind energy

Q: What companies are currently using *NuVinci* technology?

A: Fallbrook currently has agreements with:

- Allison Transmission, Inc. and Dana Limited. Each has licensed NuVinci technology for development into products for automotive applications both on highway and off-highway.

- Leading vehicle system and component suppliers under development programs in a variety of industries/
- More than 80 international bicycle and e-Bike brands from the U.S., The Netherlands, Germany, Switzerland, and Denmark. . Visit www.fallbrooktech.com/cycling/gallery to see a number of the models.
- Distributors
  - Quality Bike Products, a leading distributor to the cycling industry and authorized reseller of *NuVinci* CVP kits.
  - Seattle Bike Supply, a full service bicycle and bicycle parts distributor, and authorized reseller of *NuVinci* CVP kits for the bicycle aftermarket business.
  - J&B Importers, is a global wholesale distributor located in the US serving IBDs and distributors around the world, and is an authorized reseller of *NuVinci* CVP kits for the bicycle aftermarket business.
  - Southcott Cycles, located in Victoria, Australia, one of Australia's largest bicycle distributors. Southcott Cycles is a subsidiary of Southcott Pty Ltd.
  - Cycle Supplies, located in Christchurch, New Zealand, which provides components to bike shops throughout New Zealand.
  - PSI (Perfect Sport International), located in Taiwan and China
  - Sanyo Trading Co. Ltd, located in Japan.

A number of other customer agreements have not been announced.

Bicycle FAQ's

NuVinci® Experience

Q: How does the NuVinci® hub impact the riding experience?
A: The short answer: It is unlike anything you have experienced before.

You'll find yourself shifting without thought, whenever you feel like it - while you're pedaling, when you're coasting (freewheeling), when you're pedaling backwards, even when you're stopped. There's no hesitation, no noise, no waiting for the mechanism to "hunt" for the gear you've selected, nothing to synchronize, nothing to guess at, a simple twist of your wrist and you're at a new ratio. Say goodbye to racking your shins and dropped chains due to derailleur miss-shifting. You'll easily find your sweet-spot; adjust your cadence for max power, or up-shift at will to work your legs a bit more. With the *NuVinci* hub, you're easily in charge of your riding experience.

Q: What are people saying about hubs with *NuVinci* technology?
A: Reaction to the *NuVinci* CVP hub has been nothing short of phenomenal. Bicycle industry executives and consumers alike are quoted as saying:

- "Smooth", "very smooth" "very smooth, unbelievable", "silky"
- "It's so easy to shift and maintain a perfect cadence."
- "Takes the worry out of shifting"
- "I haven't missed riding a bike until now"
- "It is the best transmission on a bicycle"
- "I have seen nothing like it"
- "[this] technology is a great fit…."
- "The ride quality is ready now!"
- "I want it now!"

N360™ Drivetrain

Q: What is the ratio range and efficiency of the NuVinci® N360™ Drivetrain?
A: From bench and road testing by potential consumers and industry experts, the *NuVinci N360* drivetrain compares favorably with internally geared hubs on the market today and has the same or better ratio range. The nominal ratio range of the *N360* Model is 360%. In a double front sprocket installation, the range is significantly larger. A gear inch and ratio range comparison chart is available in the Cycling section of the Fallbrook website.

Q: How much does the NuVinci® N360™ Hub weigh?
A: The *N360* model weighs approximately 2450 grams. While the weight of the *NuVinci* rear hub may be greater than that of a rear derailleur drivetrain, multiple chain rings, a cassette and dual shifters are not required.

Q: Is there any required maintenance?

A: The *N360* hub is provided with permanent lubrication and the CVP internals are maintenance-free for the life of the product. The *N360* internal freewheel mechanism is serviceable. The *N360* components are sealed and well protected from the external environment. Periodic light cleaning of the bicycle and hub is recommended during the winter season to prevent surface damage from road salt.

Q: How durable is the NuVinci® CVP hub?

A: The *NuVinci N360* hub has a two-year limited warranty. A durability flyer is available in Product Information – *N360* in the Cycling section of the Fallbrook website.

Q: What does a NuVinci® N360™ drivetrain cost?

A: Fallbrook is dedicated to developing affordable, advanced technology. The manufacturer suggested retail price (MSRP) of the *NuVinci N360* kit, including drivetrain and shifter from North American bicycle dealers is US $399. In Europe, the suggested retail price is EUR 314 excluding VAT.

Q: Where can I obtain a bicycle with a NuVinci® N360™ drivetrain?

A: See the "Where to Buy" or "Gallery" page for a complete listing of brands offering bicycles and e-Bikes with *NuVinci* drivetrains in the Cycling section of the Fallbrook website.

Q: Can a NuVinci® N360™ drivetrain be installed on an existing bicycle?

A: Yes. Consumers may order / purchase a *NuVinci* CVP drivetrain and controller as a kit by itself or pre-laced in a wheel from local bicycle retailers. Ask your local bicycle retailer to order an *N360* drivetrain kit from the distributors listed below. *N360* drivetrains are available with either 32 or 36 spoke holes, but only for a 135mm dropout. Installation of the *N360* in a vertical dropout requires a chain tensioner.

Bicycle retailers can order *NuVinci* CVP kits from the following distributors:

Europe
Use the online ordering system for dealers
http://www.nuvinci.com/eurosales

In the USA
Quality Bike Products www.qbp.com
Seattle Bike Supply www.seattlebikesupply.com
J&B Importers www.jbimporters.com/web

Southcott Cycles (Australia) www.couthcottcycles.com
Cycle Supplies (New Zealand) www.cyclesupplies.com
Sanyo Trading Co. Ltd (Japan) email: h-yoshida@sanyo-trading.co.jp
Perfect Sport International (China & Taiwan) www.psi-sport.com

Harmony™ Auto-Shifting Drivetrain

Q: **What are the primary *Harmony* system benefits to the cyclist?**
A: The *Harmony* system offers the cyclist a smooth, quiet, auto-shifting experience like no other drivetrain. Simply select a desired cadence, ride and forget about shifting. With the *Harmony* system continuously auto-shifting and optimizing the ride, riders can also experience improved range and greater performance out of the e-Bike.

Q: **What is the cost of a *Harmony* system?**
A: Fallbrook is dedicated to providing affordable, advanced technology. The *Harmony* system is attractively priced to e-Bike manufacturers. The e-Bike manufacturers will set the price of their vehicles equipped with the *Harmony* system.

Q: **Is the NuVinci® *Harmony* system available in an aftermarket kit?**
A: Not at this time.

Q: **Where can I purchase an e-Bike with the *Harmony* system?**
A: There are a number of world-class e-Bike brands now offering models with the *Harmony* intelligent drivetrain system. Please check the gallery page at www.fallbrooktech.com/cycling/gallery for the latest available brands.

Q: **What are the major components of an auto-shifting *Harmony* intelligent drivetrain?**
A: All *Harmony* systems come with the *N360* continuously variable drivetrain in the rear wheel. A weather-sealed *Harmony* Hub Interface attached to the *N360* monitors cadence, bicycle speed and auto-adjusts ratio. A choice of either a Base Controller (three pre-programmed cadence settings) or an Advanced Controller (offering both automatic and manual shifting) provide a simple, intuitive user interface.

Q: **Is the *Harmony* system only available for e-Bikes?**
A: Although the *Harmony* system will work on conventional pedal bikes, it is only available for e-Bikes at this time.

Q: **How does the *Harmony* intelligent drivetrain work?**
A: *Harmony* system draws its power from the e-Bike's 12-48V battery. The cyclist selects the desired cadence setting for the ride on a simple, intuitive controller located on the handlebar and then simply rides.

On Road / Off Road FAQs

Q: How is the NuVinci® CVP different from conventional transmissions?

A: The *NuVinci* CVP offers a wide range of advantages over conventional transmissions. These advantages include:

- Less complexity
- Greater powertrain system efficiency
- Greater acceleration and optimum performance
- Easier shifting
- Ability to accept multiple inputs while varying speed and managing torque
- Multiple power outlets such as for a power take off (PTO) application
- Easier to package and potentially lighter
- Easier and less costly to manufacture
- Greater scalability and potential to reuse tooling
- Improved hill-climbing

Q: How is the NuVinci® CVP different than traditional IVTs and CVTs?

A: Unlike conventional transmissions that have a fixed number of gears or output speeds, a continuously variable planetary transmission (CVP) has an unlimited number of speed ratios between its high and low limits. This allows the engine or motor to stay within its peak efficiency or peak power operating speed more than the conventional transmission. The *NuVinci* technology is a CVP that is based on a set of rotating, tilting balls clamped between two rings. Torque from an engine, motor or other input source is transferred through an input disc to the balls via the contact between the balls and the input disc. The torque is then transmitted through the balls, each of which rotates about its own separate axle, and then to the output disc via the contact between the ball and the output disc. The input disc and output disc are clamped onto the balls tightly so that the requisite amount of clamping force is provided for the amount of torque being transmitted. A transmission fluid provides traction, and prevents metal to metal contact, between the balls and discs while providing lubrication for bearings and other components. The speed of the input disc compared to the speed of the output disc, or speed ratio, is controlled by the angle of the ball axles relative to the axis of the transmission.

Q: How much more will the NuVinci® technology add to the price of my next vehicle?

A: Unlike conventional transmissions that have a fixed number of gears or output speeds, a continuously variable planetary transmission (CVP) has an unlimited number of speed ratios between its high and low limits. This allows the engine or motor to stay within its peak efficiency or peak power operating speed more than the conventional transmission. The price will ultimately be determined by the company integrating *NuVinci* technology into their products. However, because *NuVinci*-enabled products can be manufactured with standard manufacturing processes and traditional materials, the cost should be reasonably attractive. When you consider the fuel economy savings and the reduced wear and tear on related components, we believe there will be a favorable payback.

Q: **How can I get NuVinci® on my next vehicle?**

A: *NuVinci t*echnology is currently featured on many bicycles and e-Bikes. Fallbrook is in various stages of discussions, development agreements and/or licensing partnerships with companies in its primary target industries, including the automotive, heavy-duty commercial vehicles, lawn and garden and power sports industries. We expect *NuVinci t*echnology to be commercialized in a variety of applications over the next several years. Please check our website regularly for the latest news on commercial products equipped with *NuVinci* technology.

Q: **Can NuVinci® technology be utilized as a retrofit or aftermarket application?**

A: Fallbrook is currently examining how *NuVinci* technology can be integrated in both original equipment and aftermarket applications.

Q: **How can I learn more about becoming a strategic partner with Fallbrook Technologies?**

A: You can reach our engineering and business development teams by calling 1-888-NuVinci (USA Toll Free) or +1 512 279-6200 (Outside USA) – or by going to www.fallbrooktech.com/about/contact-us. Your call or e-mail will be routed to the appropriate contact who will follow-up with your communication.

Accessory Drive FAQ's

Q: **How does NuVinci® DeltaSeries accessory drive technology improve fuel economy without sacrificing performance?**

A: *NuVinci* CVP technology is at the heart of every *DeltaSeries* accessory drive system. This game-changing technology in an air conditioning compressor, for example, decouples compressor speed from engine speed, enabling the compressor to operate in its optimal range based on demand regardless of engine RPM. As a result, the *NuVinci DeltaSeries* compressor drive delivers the ideal compressor speed all the time – optimizing air conditioning operation and performance while putting less strain on the engine and improving fuel economy. This same system optimization, fuel savings and performance improvements can be similarly realized in other accessory applications.

Q: **How much more will an accessory system cost with NuVinci® *DeltaSeries* technology?**

A: The price will ultimately be determined by the company integrating the technology into their accessory system. However, because *NuVinci*-enabled products can be manufactured with standard manufacturing processes and traditional materials, their cost should be reasonably attractive. When you consider the fuel savings, performance gains and the reduced wear and tear on the accessory, we believe there will be a significant payback to the vehicle owner.

Q: **How can I get NuVinci® accessory drive technology on my next vehicle**?

A: *NuVinci* technology is currently featured on many bicycles and e-Bikes. Fallbrook is in various stages of discussions, development agreements and/or licensing partnerships with accessory manufacturers in the automotive and heavy-duty commercial vehicle markets. We expect *NuVinci* accessory drive technology to be offered in a range of accessory systems over the next several years. Please check our website regularly for the latest news on commercial products equipped with *NuVinci* accessory drive technology.

Q: **Can NuVinci® technology be utilized as a retrofit or aftermarket application?**

A: Fallbrook is currently examining how *NuVinci* technology can be integrated in both original equipment and aftermarket applications.

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NuVinci® Milestones

2004

- Technology branded *NuVinci* continuously variable planetary; previewed at Interbike 2004 Expo, Las Vegas.

2005

- Fallbrook closes $8.2 million private funding round.
- Fallbrook and *NuVinci* technology officially introduced.
- National Renewable Energy Labs presents *NuVinci* technology at WindPower 2005 Conference. Reports significant savings in cost of energy.
- *NuVinci* CVP prototype selected as “Most Potential” at Interbike show.
- ATC becomes first *NuVinci* manufacturing partner.

2006

- Valvoline signs development / trademark licensing agreement to supply *NuVinci* traction fluid.
- Ellsworth becomes first bike maker for *NuVinci* CVP; announces plans to introduce new line of performance lifestyle bikes around *NuVinci* technology.
- Fallbrook business model featured in Intellectual Property article.
- Fallbrook closes $16 million funding round.
- *NuVinci* commercial product officially introduced at Interbike 2006; Batavus bike and IZIP scooter e-bike customers deals announced; Ellsworth NuVinci bike unveiled.

2007

- ATC ships first commercial products in volume.
- Batavus Adagio-*NuVinci* bike wins Bike of the Year Honors at FietsVak Netherlands; *NuVinci* wins Innovation of the Year.
- *NuVinci* LEV technology presented at EV Conference in Taiwan; Company proposes e-Bike ratings standard.
- *NuVinci* bikes, LEVs, Lawn & Garden and Automobile technology featured on SD ABC television news.
- *NuVinci* featured on BBC broadcast; LEV technology presented at European EV Conference in Brussels, Belgium.
- *NuVinci* CVP wins 2007 R&D 100 Award, voted top100 most significant technology advancement of the year.
- Ellsworth The Ride™ Performance Lifestyle bicycle powered by *NuVinci* drivetrain wins Popular Science Magazine’s 2007 “Best of What’s New Grand Award – Recreation Product.”

2008

- Fallbrook purchases ATC's *NuVinci* manufacturing assets.
- Fallbrook announces decision to create in-house manufacturing capability for *NuVinci* drivetrains for bicycle and LEV markets.
- Fallbrook selects MTD Products Inc as its prime supplier for the manufacture of *NuVinci* CVPs.
- *NuVinci* CVP drivetrain wins iF Design / EUROBIKE Gold Award 2008.

2009

- Fallbrook spins out its Viryd division as a standalone company, which licenses *NuVinci* technology for use in wind power applications.
- Fallbrook closes $25.4 million venture investment round, led by NGEN III, LP and Robeco.
- Fallbrook begins offering the *NuVinci* Developer Kit.
- Fallbrook introduces *NuVinci* CVAD (continuously variable accessory drive) capability.
- Fallbrook creates Bicycle Products Division.

2010

- Fallbrook Technologies Inc. enters Automotive Market with NuVinci® DeltaSeries™ accessory drives, drivetrains first in industry to increase both fuel economy and vehicle performance.
- Fallbrook Technologies' NuVinci® *DeltaSeries* drive test demonstrates potential for annual fuel savings of up to $1,500 for bus AC unit.
- Fallbrook introduces all new N360™ CVP bicycle drivetrain, significantly lighter, smaller, smoother-shifting and lower cost than predecessor models.
- *NuVinci* CVP drivetrain wins a second iF Design / EUROBIKE award for the *N360* Model.
- Fallbrook Technologies Inc. raises US $39 Million in Series E Financing to Accelerate Commercialization of NuVinci® Transmission Technology.

2011

- Fallbrook Technologies Inc. Establishes Advisory Board for Automotive Product Definition and Development.
- China's Shanghai (Yangpu District) government selects Fallbrook Technologies, ASL to develop transmission drives for electric vehicles.
- Fallbrook acquires the business assets of Hodyon LP, developer and manufacturer of the Dynasys™ auxiliary power unit (APU). Hodyon operates as a wholly owned subsidiary.
- Fallbrook Technologies and Shentong form a joint venture to develop and market NuVinci® Technology in China.
- Fallbrook Technologies introduces first automatic CVP shifting system for bicycles. A new era of cycling experience begins with NuVinci® Harmony™ intelligent drivetrain.
- Fallbrook Technologies, TEAM Industries, and Tomberlin® accelerate integration of NuVinci® DeltaSeries™ system in electric vehicles.

2012

- Launched a world-class website using sophisticated geospatial and multilingual technology to serve a burgeoning global audience.
- Signed licensing agreements for automotive primary transmissions with Allison Transmission, Inc. (NYSE: ALSN), Dana Limited Corporation (NYSE: DAN).
- Signed an exclusive licensing agreement with Team Industries, Inc for use of *NuVinci* CVP technology in North America and Europe for electric and gasoline light vehicle applications.

Executive Management

William G. Klehm III
Chairman and Chief Executive Officer

Bill Klehm joined Fallbrook as Chief Executive Officer in April 2004. He has over 20 years of automotive-related experience and has held several positions with management responsibilities in the automotive business, including finance, marketing, sales, product development, and manufacturing operations. Previously, he served as the president and general manager of Newgen Results Corporation, an automotive customer relationship management firm. Prior to joining Newgen, Bill served as president and SBU director for Visteon Climate Control Systems Ltd. He helped develop and launch Visteon's Aftermarket Division. He started his career with Ford Motor Company in 1985 and held a variety of posts within the Ford Customer Service Division where he was responsible for developing and executing the marketing/growth strategy for its customer service parts business.

Bill holds a B.A. in Management and Marketing from Northwood University and also participated in the Harvard Business School Executive Education Programs.

Sharon A. O'Leary
Chief Legal Officer, Secretary and Vice President of Human Resources

Sharon O'Leary joined Fallbrook in September 2010. She has over 25 years of increasingly responsible legal experience. Her experience includes leading the way for a company to establish the necessary internal controls and corporate governance mechanisms to implement the Sarbanes Oxley Act as well as leading a company to a successful IPO. Prior to joining Fallbrook, Sharon served as the General Counsel at Phorm, Inc., working in the London office. Phorm provides a product to Internet Services Providers. She began her legal career as an assistant deputy attorney general for the New York State Organized Crime Task Force. Subsequently, she served in a variety of legal capacities for U.S. West, was a partner at Browning, Kaleczyc, Berry & Hoven, P.C. in Helena, Montana, and served as the Vice President – Law at MediaOne Group, Inc. when it was spun off from U.S. West. Sharon left MediaOne in 2000 to become the Senior Vice President & General Counsel for LoneTree Capital Management, a private equity fund formed by former MediaOne executives.

Sharon subsequently joined TeleTech Holdings, Inc., a customer relationship management firm, as Senior Vice President, General Counsel & Secretary. In 2005, Vonage Holdings Corp. hired Sharon as its first in-house general counsel and she assumed a leadership role in managing the provision of all legal support necessary to take the company public.

Sharon holds a Bachelor's Degree cum laude from Dominican College, and a J.D. cum laude from New York Law School.

David Hancock
Executive Vice President, Cycling Division

David Hancock joined Fallbrook as a result of Fallbrook's purchase of the business of Hodyon LLP. He is currently Executive Vice President, Product Business Units. His responsibilities include the Dynasys™ APU Division and the Bicycle Division. David worked in the mobile air conditioning business starting in 1994. He began in retail and service and then in 1997, founded and became the Chief Executive Officer of Hodyon.

In 2004, David was part of the innovative 10H development team that was responsible for the Aftermarket A/C division of Hodyon. Starting in 2009, David guided Hodyon out of the mobile air conditioning business by selling Hodyon's Aftermarket A/C division and leading the launch of Hodyon's Auxiliary Power Unit (APU) division. The transition from mobile air conditioning to APUs led to Hodyon's acquisition by Fallbrook Technologies. David served as Hodyon's CEO until October, 2012 when he was promoted to his current position,

Prior to Hodyon, he worked as an accountant for Arthur Andersen.

David holds with a BBA in Accounting from Abilene Christian University.

Jeffrey A. Birchak
Associate General Counsel and Assistant Secretary'

Jeff Birchak joined Fallbrook in November 2003 as Vice President of Intellectual Property. He is currently Associate General Counsel and Assistant Secretary and he also continues to serve as Vice President of Intellectual Property. Jeff provides legal assistance and advice supporting all areas of the Company's domestic and foreign operations. As an intellectual property (IP) attorney with experience in IP portfolio management and strategy as well as patent defense and enforcement strategies, he has developed and managed Fallbrook's patent portfolio from its engineering development to support the Company's strategic objectives. Prior to joining Fallbrook Technologies, Jeff was an associate at Knobbe, Martens, Olson & Bear LLP. Previously, he served as a nuclear engineering instructor in the U.S. Navy submarine force, and worked as a program engineer for AlliedSignal Corporation.

Jeff holds a B.S.E. cum laude in Mechanical Engineering from Arizona State University and a J.D. cum laude from California Western School of Law where he was the managing editor of the California Western Law Review and the California Western International Law Journal. He is a member of the State Bar of California and is admitted or registered to practice before the Supreme Court of the United States, the U.S. Patent and Trademark Office and the U.S. District Court for the Southern District of California.

Jeremy Carter
Vice President of Product Development

Jeremy Carter has over 14 years of experience in development and commercialization of a wide range technology products and business activities. He joined Fallbrook in June 2004 as a product development engineer and subsequently has held several management positions.

Jeremy currently serves as the Vice President of Product Development. He has directed the majority of the company's commercial development programs including the NuVinci® N360™ and the NuVinci® Harmony™.

Prior to joining Fallbrook, Jeremy worked at Southwest Research Institute (SwRI) where he served in a variety of roles in the Drivetrain Design and Development group as a strategic consultant for the global automotive & off-road equipment industry. At SwRI, Jeremy worked over a two-year period with Fallbrook's founder to evaluate the NuVinci technology for commercial viability.

Jeremy holds a B.S. and M.S. in Mechanical Engineering from Texas A&M University, an M.S. in Technology Commercialization from McCombs School of Business at The University of Texas at Austin. He is cited as an inventor on over 15 patents and has published 8 technical papers in international journals and conference proceedings.

Brian Crum
Vice President of Operations

Brian Crum joined Fallbrook in February 2012 as Vice President of Operations. He has 20 years of domestic and international manufacturing, engineering, and operations experience in the automotive and aerospace industries. Prior to joining Fallbrook, Brian was the Manufacturing Engineering Manager for US Manufacturing Corporation in Michigan. Previously, he worked at Chrysler LLC for 12 years, where he served in a variety of roles including Staff Engineering Manager and Operations Manager for Global Engine Manufacturing Alliance (GEMA), a joint venture between Chrysler, Hyundai and Mitsubishi Motors. While at GEMA, the plant achieved world class levels of production efficiency as demonstrated by winning the Harbour Award as the most efficient engine plant in North America. Early in his career, Brian spent time at Chrysler and Ford as a Manufacturing Engineer as well as five years as an officer in the US Air Force.

Brian holds a B.S.E. in Materials Science and Engineering from the University of Michigan and an M.S. in Materials Engineering from the University of Dayton. He also holds a Six Sigma Greenbelt and attended the Leadership Development Program at the Center for Creative Leadership.

Board of Directors

William G. Klehm III
CEO and Chairman of the Board

Bill Klehm joined Fallbrook as Chief Executive Officer in April 2004. He has over 20 years of automotive-related experience and has held several positions with management responsibilities in the automotive business, including finance, marketing, sales, product development, and manufacturing operations. Previously, he served as the president and general manager of Newgen Results Corporation, an automotive customer relationship management firm. Prior to joining Newgen, Bill served as president and SBU director for Visteon Climate Control Systems Ltd. He helped develop and launch Visteon's Aftermarket Division. He started his career with Ford Motor Company in 1985 and held a variety of posts within the Ford Customer Service Division where he was responsible for developing and executing the marketing/growth strategy for its customer service parts business.

Bill holds a B.A. in Management and Marketing from Northwood University and also participated in the Harvard Business School Executive Education Programs.

R. John Hughes
Director

R. John Hughes, Executive Director / Head of Principal Investments Macquarie Capital, became the Macquarie representative on the Company's Board of Directors effective April 12, 2012. John joined Macquarie in 1997 and has worked in a number of senior roles across a range of industry sectors within the Corporate Finance Group. Prior to joining Macquarie, John was at Banker's Trust Australia with advisory/principal roles in the transport, resources and utility sectors and at the Commonwealth Bank of Australia with roles in the project finance group and in treasury operations.

Richard L. Intrater
Director

Rick Intrater has been in the investment banking and financial services industry for over 30 years. He is the President & CEO of Long-Term Solutions, a Multi-Family Office in San Francisco that he founded in 2005 to assist multi-generational families of significant wealth with financial, investment, philanthropic and administrative oversight. He also manages LTS Capital Partner I and II which provides private equity and venture investment capital to promising mid-stage companies.

Rick's previous experience includes board member and managing director of Sand Hill Advisors and the founder of Sutter Street Capital Management. He spent 13 years as Senior Vice President of Lehman Brothers in New York and San Francisco and began his career as a financial analyst for the U.S. Export Import Bank in Washington, D.C.

Rick is the Founding and past Chairman of the Board of Directors, KIPP Bay Area Schools, past President of the Boys and Girls Clubs of San Francisco, former National Trustee of the Boys

and Girls Clubs of America, former Board Member of the Coyote Point Museum of Environmental Education and Former Board Member of the Family Service Agency of San Mateo County. He is also a member of the board of directors of Fallbrook Technologies and BIO2 Technologies.

Gary E. Jacobs
Director

Gary Jacobs is an investor and philanthropist and has been a member of the Board of Directors since March 31, 2004. Since 1997, Gary has served as the Managing Director of Jacobs Investment Company LLC, which participates in real estate development and other investment activities throughout the United States and abroad. He also owns and operates a professional minor league baseball team, the Lake Elsinore Storm, affiliated with the San Diego Padres. He serves as chairman of the Board of Trustees High Tech High, a public charter high school and is a board member of the UCSD Board of Overseers. Gary's other philanthropic work includes being a past president of the United Jewish Federation of San Diego County. Additionally, he and his wife created and funded the Gary Jacobs and Jerri-Ann Jacobs International Teen Leadership Institute which promotes Muslim / Jewish understanding. Prior to his current investment and philanthropic activities, he worked as a software engineer and senior education specialist at QUALCOMM, Inc. and as a software programmer at Linkabit Incorporated. Mr. Jacobs left QUALCOMM in 2000.

Mr. Jacobs holds a B.A. in Management Science from the University of California at San Diego.

Al Kammerer
Director

From September 1, 2011 to May 15, 2015, All Kammerer served as President of Fallbrook. He has been and continues to be a member of our Board of Directors since February 10, 2009 and has also served in a consulting role to Fallbrook. Al is a seasoned automotive industry veteran who spent 34 years with Ford Motor Company before retiring in 2008 as product development director for Jaguar Land Rover. Prior to this assignment, he served as executive director for SUV and body-on-frame vehicles in North America, where he led product development activities for Ford, Lincoln and Mercury vehicles with these platforms. In his previous work with Ford, Al also served as vehicle line director for the group that developed the critically-acclaimed Ford Focus.

Al holds a B.S. in mechanical engineering from California State University at San Luis Obispo, and an M.S. in mechanical engineering from Stanford University.

Keimpe Keuning
Director

Keimpe Keuning has been a member of the Board of Directors since December 18, 2008 and is an investment director at SAM Private Equity AG, which provides investment advisory services to Robeco Group N.V., a Dutch-headquartered asset management firm wholly owned by Rabobank. Robeco was established in Rotterdam in 1929 and has offices located world-wide. Robeco offers a wide range of investment products and services to institutional and private

investors. Keimpe joined Robeco in 2006 and subsequently joined SAM in July 2009, with a focus on clean technology investments. He is also on the board of directors of Enerpulse Inc., AWS Eco Plastics Ltd. and SPG Solar, Inc. Prior to Robeco, Keimpe worked from 2001 to 2006 at Fortis Bank as Associate Director where he advised a broad range of clients on numerous transactions. He began his working career at Ernst & Young as a tax advisor.

Keimpe studied U.S. and International tax law at the University of Florida and received a master's degree in tax law from the University of Leiden. He has also participated in executive education at the Amsterdam Institute of Finance and INSEAD.

Operational Management

Barry F. Berkov
Business Support

Barry Berkov joined Fallbrook as Director of Business Support in January 2012 after having been an operational consultant to Fallbrook since 2003. He has over 35 years of senior executive and consulting experience in assisting start-up and growing early stage companies. He assists Fallbrook with overall business strategy, marketing and public relations planning, infrastructure requirements, and general management consulting. He also provides support for the development of Company's financing and investor communication documents. Barry's prior consulting clients include major corporations, small technology ventures, and venture capital firms. After relocating to San Diego in 1999, he was the President and COO of boxLot, an Internet startup and subsequently served as the interim General Manager of SignOnSanDiego, the website of the San Diego Union Tribune. Previously, Barry spent nearly 20 years at CompuServe. As the Executive Vice President of the CompuServe Information Service, he grew revenue from $97M to $393M over a four year period. Earlier in his career, he worked in various analyst and managerial capacities for Xerox Corporation.

Barry holds a B.A. in Government from Pomona College and an MBA from The University of Dallas.

Jim Thompson
Information Technology

Jim Thompson joined Fallbrook in September, 2011 as Director of Information Technology. He has over 17 years of increasing responsibility in technology planning, development, and management. Jim previously was Director of Information Management and Technology for Tepa, LLC in Colorado Springs, CO. Tepa is an environmental, engineering, and construction services firm and he was the department head responsible for all of Tepa's Corporation's information technology and information management systems. Jim built Tepa's IT infrastructure from the ground up and ultimately implemented an environment that spanned nine offices throughout seven states.

Prior to Tepa, Jim was the IT Manager for SpecPro Inc., in San Antonio, TX where he was responsible for all corporate office and division infrastructure. Earlier in his career, Jim was the Computer Operations Manager at Transactive Corporation, Austin, TX.

Jim holds a B.S. in Health Information Administration from Southwest Texas State University and has taken courses toward an MBA at Southwest Texas State University. He is a Microsoft Certified Professional (MCP) and has previously qualified as a Microsoft Certified Engineer (MCSE).

Erika Garcia-Phillips
Accounting

Erika Garcia-Phillips has managed Fallbrook's accounting operations since July of 2014. She brings with her more than 15 years of experience in accounting for domestic and international entities, financial management, mergers, and acquisitions.

Prior to joining Fallbrook, Erika served as the Accounting and Finance Director for Valoran USA, Inc., where she developed and implemented all of the company's financial and accounting workflows and revenue recognition and control processes. She has also worked with companies such as Ernst & Young LLP, KPMG, ClearCube Technology Inc.Apollo Endosurgery and ReAble Inc., in a variety of Controller roles.

Erika earned her Bachelor's Degree in Accounting and Finance from the Monterrey Institute of Technology and a Certificate of Special Studies in Business Administration and Management from Harvard University. She is a CPA l and IFRS certified.

Charles Worden
Financial Planning & Analysis

Charles Worden joined Fallbrook in 2013 to develop and lead financial planning and analysis functions for the Company. With almost 20 years of experience in corporate accounting and financial planning and analysis, he has held progressively senior roles throughout his career.

Prior to joining Fallbrook, he served as the Finance Operations Manager for Active Power, where he oversaw reporting for multiple companies in seven countries and worked with the executive team and managers for more than 30 departments. He has also held financial analyst positions in several companies — such as Ultra Electronics, American Achievement Corporation, and Cisco Systems — where he used his accounting and financial planning expertise to identify, analyze, and control each organization's operating and financial objectives.

Charles holds a B.S. in Business Administration from Concordia University Austin, with a concentration in accounting. He is a licensed CPA and is a member of the Texas Board of Public Accountancy.

Transportation Industry Advisory Board

The Transportation Industry Advisory Board (TIAB) assists Fallbrook in evaluating product requirements and market opportunities for its NuVinci® DeltaSeries™ products. The members are former executives with significant automotive business and technical experience who serve as impartial advisors. Al Kammerer, Fallbrook's president, serves as the chairman/coordinator for the TIAB.

David Cole

David E. Cole, Ph.D. is the Chairman Emeritus of the Center for Automotive Research (CAR) in Ann Arbor, Michigan. He is currently Chairman of AutoHarvest, a web-based intellectual property marketplace. Dave was formerly Director of the Office for the Study of Automotive Transportation (OSAT) at the University of Michigan Transportation Research Institute. He has worked extensively on internal combustion engines, vehicle design, and overall automotive industry trends. Dave's technical and policy consulting experience includes a variety of assignments for industry, labor, and government. His recent research has focused on strategic issues related to the restructuring of the North American industry and trends in globalization, technology, market factors, and human resource requirements. Dave was formerly a member of the Energy Engineering Board of the National Research Council and the U.S.-Canada Free Trade Pact Select Panel. He is active in SAE and served two terms on the Board of Directors. In February 1986, he was named a fellow of SAE. Dave received his B.S.M.E. and Mathematics, M.S.M.E. and Ph.D. from the University of Michigan.

Pascal Henault

Pascal Hénault joined PSA Peugeot Citroen in 1970 as Business development manager for the RAVI, a large super market chain owned by Peugeot. He then spent his entire career with PSA Peugeot Citroën where he held various positions in marketing and product development for the Peugeot brand. In 1983, Pascal became VP parts operation and in 1985, he was appointed President of Peugeot Motors of America, the PSA US subsidiary for importation and distribution of Peugeot and Citroen products. In 1992 Pascal returned to France and served as VP Product Planning for the PSA Automobile Division and in 1996, he became Peugeot Automobiles Executive VP Product and Marketing. From 1998, he held the position of PSA Executive VP Research and Innovation. He was promoted to Executive VP Research and Development and Innovation and joined the PSA Executive Committee in 2007. Pascal retired from PSA at the end of 2009 and became a consultant focused on R§D and innovation management. He is a member of the European chemical firm Rhodia's Scientific Council and senior advisor to SINNOGEN a French consulting firm based in Paris specializing in Innovation management. Pascal holds an engineering degree from Ecole Centrale Lyon and is a graduate of INSEAD.

Neil Ressler

Neil Ressler retired from Ford Motor Company in 2001 where he held the position of Vice President for Research and Vehicle Technology and Chief Technology Officer. He was also

chairman of Jaguar Racing, Cosworth Racing, Pi, Ford Global Technologies and Ecostar. Neil subsequently returned to Ford for 2.5 years in a consulting role with Product Development and the Ford GT program. Neil is presently involved with a small company, Ethanol Boosting Systems, which is developing a method to increase gasoline engine efficiency by 25-30% thru use of a small amount of ethanol. He has also recently been consulting with the IndyCar Series, assisting in development of a new rules package for 2011 which will be more relevant to the direction being taken by global auto manufacturers in the coming years. Neil holds a B.S. in Mechanical Engineering from General Motors Institute, an M.S. and Ph.D. in Physics from the University of Michigan and an M.B.A. from Michigan State University.

Rudolph A. Schlais Jr.

Rudolph (Rudy) A. Schlais Jr. is Chairman of ASL Management Consulting Company (ASL) and former CEO of General Motors Asia Pacific. He has served as in senior executive roles for China Auto Electronics Group Limited, one of the largest global suppliers of vehicle electrical/electronics distribution systems worldwide. Prior to China Auto Electronics Group, Rudy spent more than 42 years in various management roles at General Motors in component and vehicle operations, capped by his role as president and CEO of General Motors Asia Pacific. In that position, he negotiated and led GM's first Chinese vehicle operations and contributed to GM's success in capturing market share in the Asia Pacific market. Rudy has recently focused on technology investments, serving as a limited partner of Greenbriar Equity Partners LP, an executive advisory partner of Windpoint Equity LP and an LP and advisor to Key Principal Partner Equity Funds. He formed and serves as chairman of the Shanghai-based ASL Management and Consulting Company, and is a founding general partner and director of ASL Partners, a developing private equity fund focused on global Chinese manufacturing companies. Rudy is a graduate of Youngstown State University and the Massachusetts Institute of Technology. He also attended Dartmouth College's Amos Tuck Business School Executive Program. He received an honorary Doctor of Humane Letters degree from Youngstown State University.

MaryAnn Wright

MaryAnn Wright, Vice President, Global Technology and Innovation for Johnson Controls Power Solutions, previously served on Fallbrook's Board of Directors from November 2012 to February 2014. MaryAnn is an industry authority in technology, auto, finance, and operations. At Johnson Controls Power Solutions, she currently leads the Research and Development organization responsible for establishing Power Solutions technology and innovation roadmap, value chain strategies as well as leading the government relations activities to accelerate the global growth of advanced energy storage systems.

MaryAnn began her career at Ford in 1988, holding a variety of positions in finance, product and business planning, and engineering and subsequently served as Director, Sustainable Mobility Technologies and Hybrid Vehicle Programs at Ford Motor Company. In this capacity she was responsible for all hybrid, fuel cell and alternative fuel technology development. She also served as Chief Engineer of the 2005 Ford Escape Hybrid, the industry's first full hybrid SUV. In 2005, she led the launch of Ford's first hydrogen-powered fuel cell fleet program. Prior to joining

Johnson Controls, she served as Executive Vice President Engineering, Product Development, Commercial and Program Management for Collins & Aikman Corporation.

MaryAnn holds a B.A. in Economics and International Studies from the University of Michigan, an M.S. in Engineering from the University of Michigan and an MBA from Wayne State University.