



<b>Industry</b>
Controls/Sensors Medical Intervention
<b>Officers/Directors</b>
Chris Hymel (Pres/Treas/Dir) Ron Stubbers (VP/Dir) Malcolm Skolnick (Sec/Dir) Richard Seltzer (Dir)
<b>Investment to Date</b>
\$925,000 (cash) \$4,970,000 (assets/services)
<b>Capital Required</b>
\$2.5M over 12-18 months \$20M over 4 years
<b>Use of Funds</b>
Technology Refinement Specific Application R&D Sales/Marketing/Licensing Intellectual Property

**Overview:** Signal Advance, Inc. (SA or the Company) has developed and is pursuing licensing and commercialization of its proprietary Signal Advance (SA) Technology which acts to reduce signal detection delays associated with a variety of physical sensors, thereby improving performance in control, intervention, and/or signal transmission systems.

**Challenge:** Delay associated with the detection, processing and response to various signals negatively impacts response time and thus performance. For bioelectric signals (e.g. cardiac or brain signals), the greater the detection, processing and response delay, the more difficult it is to successfully intervene to contain or limit a pathological process such as cardiac fibrillation or an epileptic seizure. The earlier the intervention is initiated, the greater the probability of success.

Non-medical applications (defense, process control, energy, transportation, etc.), early signal detection means faster control system response - improving efficiency, accuracy, safety, product yield, fuel efficiency and reducing waste/emissions. In transportation, faster closed-loop response time could improve safety/accident avoidance and improve fuel efficiency. Industrial examples include such improved compressor performance and increased petrochemical yields. In defense applications, such as targeting and early detection systems, the earlier detection of the presence of a projectile or changes in target position, velocity or acceleration, the greater the targeting accuracy or the better the odds of avoidance if targeted. In high performance aircraft engines, SA technology could increase stability, reduce stall margins, improve performance and fuel efficiency.

**Solution:** SA technology can offset these signal detection and processing delays and improving performance. The technology is based on "negative group delay", a well documented phenomenon in wave propagation physics. In conjunction with other approaches such as faster electronics, SA technology can be applied to reduce delays in maximally enhancing system performance which may enable the development of novel control/interventional approaches.

**Market:** SA has identified whole classes of sensors with signal characteristics suitable for applying its technology, broadening its range of licensing targets. The addressable markets include medical (e.g. cardiac rhythm management, neurostimulation) and industrial sectors including transportation (vehicular/flight control, accident avoidance), defense (weaponry, targeting), manufacturing (process control, automation) and energy (generation, distribution). With any new or disruptive technology, recognition and acceptance will gain momentum over time.

In medicine, the application of SA Technology to temporally advance bioelectric and other signals can potentially improve performance in interventional medical devices. Projections in major medical markets include: Cardiac Rhythm Management (CRM): \$28B by 2017 (CAGR: 9.8%); Neurostimulation: \$8.8B by 2020 (CAGR: 4.3%); Magnetic Resonance Imaging (MRI): \$6.9B by 2018 (CAGR: 5%); Radiation Therapy: \$8.1B by 2019 (CAGR: 6.7%). Digital Brain Health: \$2.0B in 2012, \$6.0B by 2020 (CAGR: 25.1%) For these and other medical devices, improved performance translates directly to increased value - providing significant revenue opportunity.

There are also a wide range of industrial markets for SA technology. The global sensor market was valued at \$69B in 2012 and projected to be \$54.4B by 2020 (CAGR: 10.1%); Image flow & level sensors: \$50.2B by 2020 (11.7% CAGR); Biosensors and chemical sensors: 32.8B by 2020 (CAGR: 11.5%). The industrial control/factory automation market was \$108.80B in 2015 and expected to reach \$153.30B by 2022 (CAGR: 4.88%). The automotive sensors market was 20.27B in 2014 and projected to reach \$33.37B by 2021 (CAGR: 8.7%). The projected market contribution is 1-3%.

**Intellectual Property:** In 2007, Steven Weeks, Ph.D. (solid-state physics), First Principals, Inc. performed an independent intellectual property (IP) valuation based solely on the "cardiac" and "neuro" device market segments and drew the following conclusions:

**VALUE:** Including the projected, risk-adjusted licensing royalties, we project A NET PRESENT VALUE OF UP TO ~\$10.4 MILLION.  
This valuation will increase rapidly as the technology is proven and then successfully applied to products in this very large market.  
... IT IS, HOWEVER, DELIBERATELY CONSERVATIVE.

Patents have been granted in China (2012), the US (2013), Mexico (2104), India (2019) and Europe (2017). In Europe, the patent was validated in France, Germany, Ireland, Italy, Spain, Switzerland and the United Kingdom. Additional patent applications are in preparation for specific application, circuits and signal processing to improve signal fidelity. We have also registered "Signal Advance" as a trademark for Class 10 medical devices.

IP defense strategy derives from the application-specific nature of the SA technology design, enabling novelty and non-obviousness in patent claims with the associated analytical methods remaining trade secrets. Potential infringers would have to expend undue time and money to develop such methods to pursue individual applications. This application-specific approach gives the Company a significant competitive advantage as individual SA applications will have their own patent filings and stand independently. An attack on any one will not affect others.

Searches and analyses of the patent and scientific literature have not revealed any prior art that would negate the utility and novelty of SA technology. No combination of the references seems to render the technology obvious to a person skilled in this area. However, the defensive strategies, outlined above, and constant vigilance are required.

**Competition:** Quotes from 3<sup>rd</sup> party experts regarding SA Technology: "...seminal in concept"; "...SA has no current competition"; "...truly 'pioneering' or 'landmark'..."; "I expect to see Mr. Hymel's methods and related systems come to underlie groundbreaking advances"; "...revolutionize the non-pharmacological treatment of arrhythmias and epilepsy"; "...seen as a disruptive technology that forces rapid change...early adopters...gaining a significant commercial advantage..."; "...key to effective seizure suppression".

Indirect competition exists as in the form of ever faster electronics used to improve signal detection and processing performance. In addition, alternate control strategies, (e.g. predictive feedback and feed-forward) are often used to improve performance but also have significant drawbacks. Faster electronics alone will reduce, but never eliminate, circuit delays. For a number of applications, these techniques may be adequate. SA technology can be used in conjunction with these methods to further improve performance.

While SA is not aware of any direct competition, its own success will likely precipitate competition as SA technology gains recognition and acceptance. This will include potential infringement and legal machinations based on a larger, financially successful firms' capability to engage in lengthy and expensive litigation.

**Revenue Generation:** While the addressable market is in the billions, it is expected that many licensees will require exclusivity which would limit SA to a single license in a given application area. SA will target multiple application areas to generate licensing revenue. Revenue generation will derive from licensing the intellectual property to product manufacturers, consulting with licensees on implementation of the technology in target applications, participating in joint ventures and commercializing SA enhanced products.

**Marketing strategy:** The marketing approach includes identifying application targets, consulting with application experts, developing the application-specific SA technology, protecting the intellectual property, demonstrating performance improvement to target licensee, and securing licensing/consulting agreements. As SA technology gains recognition and acceptance, these development costs will shift to the client. Target market applications are selected based on the intervention/control impact, signal characteristics, overall market size, supplier market share, competition, and regulations.

**Progress:** The Company continues to refine its proprietary technology and has established collaborations with research institutions and private companies to develop SA Technology in specific application areas. The Company is has entered the brain health market by and is developing application-specific SA technology for neural-electric (brain) signals and has entered a joint venture to develop proprietary Neural Training delivery systems.

Independent validations of Signal Advance technology have been established in the following areas:

**Scientific:** Prototype Signal Advance circuitry, developed for bioelectric signals (cardiac) was rigorously tested using a range of simulated signals and actual ECG signals from cardiac patients. This development activity and experimentation resulted in completion of a successful doctoral dissertation study at the University of Texas Health Science Center at Houston;

**Technical:** A peer-reviewed feature article summarizing the technology, study results, and broad range of potential SA Technology applications was published in the IEEE Circuits and Systems Magazine in the third quarter of 2011;

**Commercial:** SA was awarded first place in the 2011 Goradia Innovation Prize competition. The selection was based on the commercial potential of the technology, soundness of the business plan, potential for job growth within the region, and likelihood of significant long-term success.

**Innovation:** Dr Hymel was named 2012 Innovator of the Year by the Oklahoma Bar Association Intellectual Property Section. Dr. Hymel was also named 2015 Inventor of the Year by the State Bar of Texas Intellectual Property Section. Recognition was based on Dr. Hymel's development work and patents related to Signal Advance technology.

**The Team**

**Chris M. Hymel, Ph.D.** B.S./M.E. in electrical engineering; Experienced entrepreneur; Engineering/ scientific consultant; Technical manager; Author/co-author of scientific and technical publication; Multiple patent holders, including company's intellectual property. Dr. Hymel is experienced in startup & early stage companies as well as taking a company public.

**Ron Stubbers, B.S., M.B.A.** held engineering and production management positions in start-ups and early-stage companies; Experienced in product development, production, world-wide client fulfillment, quality control and regulatory requirements. Mr. Stubbers holds multiple patents. Mr. Stubbers holds an MBA and bachelors degree in electrical engineering.

**Malcolm Skolnick, Ph.D., J.D.** Theoretical physicist, former tenured professor and director of technology transfer at the University of Texas Health Science Center - Houston, former president and CEO of a publicly traded biotech firm (10 yrs). Dr Skolnick is a registered patent attorney, licensed to practice in Texas, and experienced biomedical researcher with related publications/patents.

**Richard Seltzer, J.D., LL.M.** Licensed to practice and is an approved mediator in the State of Texas, LLM in Taxation; Experienced in corporate and tax law, mergers and acquisitions and contract/license negotiations, business litigation, shareholder disputes. Mr. Seltzer lectures on general business law matters as an invited speaker.

**Michael Watson** (Electronics Technologist) Instrumentation, measurement, communications and control systems specialist with 30+ years of experience in analog and digital electronics development. Specializing in measurement and control techniques, Mr. Watson has been involved in multiple OEM relationships to develop application specific equipment and integrated solutions.

<b>As of December 1, 2019:</b>	
<b>Common Stock</b>	
Authorized:	200,000,000
Issued/outstanding:	91,530,000
Held by Parent Co:	75,000,000
Restricted:	87,299,565
Unrestricted:	4,283,992
Held at DTC:	1,547,251
No. of Shareholders:	185
No options/warrants issued.	
No pending legal actions	
No convertible debt	