2009

G. Wallace F. McCain Institute for Business Leadership

University of New Brunswick

SUCCESSION PLANNING AT MEASURAND

Scott Thomson prepared this case with [] assistance for the purposes of classroom discussion rather than to illustrate either effective or ineffective management practice.

TABLE OF CONTENTS

Ideal...Ideas, the Quest for Success

In the early autumn of 2008, the employees of Measurand were sitting in the ballroom of a Halifax, Nova Scotia hotel to watch Lee Danisch, the founder of their company, accept his fourth award of the year: the $25,000 Dave Mitchell Award of Distinction. As with all nominees, Danisch appreciated the recognition for developing the ShapeAccelArray™, an innovative sensor that detects subtle movements in the ground to forewarn of landslides. As he sat enjoying the evening, however, Danisch and his team were already thinking about what was next for this Fredericton-based technology firm. Now in his 60s, Danisch was thinking about retirement. While it took the entire team to develop the ideas into usable products, Danisch came up with the initial ideas. This had been the case since the beginning; Danisch's creativity and imagination could not be quantified or explained, but it lay at the heart of Measurand's success. Danisch's thoughts about retirement forced him and his team to confront the one question they had been avoiding: Can you replace the ideas guy and if so, how?

The Potter-Engineer

After earning an undergraduate degree in electrical engineering at Georgetown University Danisch headed to the Massachusetts Institute of Technology (MIT). In 1968 he graduated with a Master's in electronic engineering. While working as a researcher implanting electrodes in the brains of mice at Boston University's medical centre, he decided to study philosophy and pottery at Reed's College. Philosophy, because he thought it was important to understand different viewpoints; pottery, because he needed an artistic outlet and he was not much of a painter.

After working for three years at Boston University, Danisch traded in the big city for country living, moving a day's drive north to Sussex, New Brunswick, Canada (see **Exhibit 1**). Danisch wanted to become part of the back-to-the-land movement; the electrical engineer became a hippie. Danisch initially planned to move out to Newfoundland, Canada's most easterly province, but a chance pit stop in Sussex changed his mind. In the backwoods of Sussex, a community of like-minded people formed, including Danisch, who cleared some land to build a home and a pottery studio.

Danisch, however, did not completely abandon the engineering world. He applied for, and received, a grant from the National Research Council (NRC) to develop microgenerators that would produce electricity from small streams. This was Danisch's first introduction to the NRC, a government research organization that would be instrumental in supporting Danisch's research at Measurand. Danisch continued to work on microgenerator development of the microgenerators while devoting the majority of his time to pottery.

By 1980 Danisch was married and raising two children on a potter's income. It was time, he decided, to return to engineering full-time. He started with some engineering consulting work in Sussex, and then the NRC introduced Danisch to Process Technologies Limited (PTL). PTL manufactured semiconductors in Fredericton, New Brunswick's small provincial capital, about 125 kilometres north of Sussex. Initially, Danisch was a consulting engineer but he eventually accepted a full-time position as PTL's vice-president of development. In that role, Danisch oversaw the development and manufacturing of new products.

The Evolution of Measurand

In1986 Danisch left PTL, which he believed had grown too big, too fast and caused major financial difficulties. Danish accepted a position at the Research and Productivity Council (RPC), a Fredericton-based independent contract R&D and technical services organization. As the head of RPC's electronics department, he helped clients commercialize ideas and inventions. This usually involved working with sensors; for example, one particular client wanted to design sensors for the sport of race walking. Race walking rules require that walkers always have one foot on the ground; this is a difficult task to police during a race. RPC's client wanted sensors that could be placed in competitor's shoes to alert race officials if both feet left the ground. Danish and Terry Patterson, an electronic designer who would later join Measurand, designed the sensor.

Danisch, on his own time, began experimenting with optical fibre, which transmits light instead of electrical current. These fibres are capable of transmitting signals, such as hundreds of phone calls or hundreds of video channels. Danisch wanted to know if it was possible to use the light transmitted by the fibre to measure the height of a liquid. Danisch was able to get the amount of light going through the fibre to change as the height of the liquid changed. Although, in the process, he also noticed the amount of light would change when the fibre bent. By sending light down one side of a loop of fibre and measuring how much light came out the other side he could tell how much the fibre had bent by the amount of light coming out. The amount of light would increase if he bent the fibre one way and decrease if he bent the fibre the other way. It was a simple, yet largely unexplored idea and Danisch saw its potential. In 1993, he applied for, and received, a grant through the NRC's Industrial Research Assistance Program (IRAP), which provides financial assistance to companies for research that is intended to lead to commercialization. The funding enabled Danisch to leave RPC and found Measurand, to develop and commercialize Danisch's invention.

Invention to Commercialization

NRC funding allowed Danisch to hire Measurand's first employee, Scott Thomson, who had a background in electronics and accounting. While the treated fibre seemed like an innovative and cool idea, Thomson had a hard time seeing the practical applications of the technology. But soon after, Danisch and Thomson introduced the ShapeSensor to the marketplace, mainly through general sensor trade shows. There they quickly learned they would have to develop the general bend sensor into a specific product. Over an 18-month period the pair developed several different applications, but only one was commercially viable, the large joint angle sensor, which measured the joint angle of an elbow or a knee. This not only gave Measurand its first commercial product, but also inspired Danisch to consider how to create a sensor that could be mounted on multiple spots to measure an entire limb.

Danish caught the attention of the Canadian Space Agency (CSA), which in late 1995 contracted Measurand to develop a two-arm robotic controller. This leap from a single joint angle sensor to a two-arm robotic controller was the second of many ideas that seemed unlikely to produce results. It was difficult to mount these sensors on one joint consistently enough to measure that joint. It seemed impossible to mount many sensors on all the joints necessary to measure the whole arm and hand. The challenge of figuring out how to mount the sensors led Danisch to a new development: ShapeTape™, an array of individual bend sensors mounted on one, very thin, metal substrate. The sensors measure the metal's bends and twists, relaying messages to a computer, which then builds a three-dimensional image. A ShapeTape™ user can attach it to any object, including an arm, and get a real-time, three-dimensional image of that object.

ShapeTape™ did not seem likely to succeed when Danisch first presented it to Space Agency officials. The initial ShapeTape™ took a full day to calibrate, it was hard to build, impractical to use, and had complicated software to run it. But, by the end of the project Danisch's ShapeTape™ performed just as Danisch had envisioned. The Space Agency project included enough funding to hire an electronic designer and a software developer. It also inspired Danisch's next idea: extending the ShapeTape™ for use across the whole body. It took the Measurand team just over a year to develop the ShapeWrap full body motion capture system. Their excitement at completing the application was short-lived: shortly after completing it, Carl Callewaert, an animator hired by Measurand, told Danisch the ShapeWrap data was unusable. While the data showed the limbs moving when the person wearing the system moved, the data was not accurate enough for animation. Callewaert showed Danisch and the development team what needed to be done to improve the data. Danisch and his team went back to work, and in 2000 with Callewaert's help, Measurand released ShapeWrap II, a portable, wireless, full-body motion capture system.

Competing in the Motion Capture Marketplace

Motion capture uses sensors to measure the movements of an actor and then uses that data to animate characters for digital films such as the Polar Express™ or games such as World of Warcraft™. ShapeWrap II was designed for educators to teach the motion capture process. It represented a small niche that Measurand carved out in a growing industry sector that, in 2006, reported annual sales between $50 million and $100 million[1], including motion capture for biomechanic analysis and animation. Comparatively, the digital content creation market was $3 billion dollars[2].

Measurand is one of three mid-level motion capture companies. Its competitors are Animazoo and Xsens, companies that are slightly larger than Measurand. Both offer systems that use similar technology to each other and are priced at $80,000 for the Animazoo system and $60,000 for the Xsens system. Measurand, the smallest of the three firms, offers its ShapeWrap II system for $40,000.

Mid-level systems are portable and lack the pinpoint accuracy of high-end systems. Danisch believes the ShapeWrap system has three advantages over its competitors: it is designed for a specific user – educators and their students, because of that it offers added value with a 44-week curriculum guide and it remains the only company to offer full-finger motion capture.

---

[1] Computer Graphics World, Volume 30, Issue 10 (Oct 2007), Article Moving on Up, (www.computergraphicsworls.com)]
[2] Ibid.

The low-level motion capture systems are not portable and are either lower in price or lower in quality. The average price range is between $5,000 and $20,000. Despite these drawbacks, Measurand considers these companies, the majority of which are new industry entrants, a threat to its sales base. Many people are getting into motion capture but without knowledge of what motion capture is and what it can or cannot do. People will find the low price attractive and buy without regard to quality.

Tackling the Engineering Sector

After a decade in business, there was a well-established rhythm to Measurand's development: each new product would send Danisch back to the drawing board. Measurand's growth had been evolutionary in nature, with each new product born from its predecessor in Danisch's lab. A second potential market emerged: the engineering sector. Engineers were interested in ShapeTape™'s ability to measure both static and dynamic environments because of its ability to measure bend and twist. Few sensors measure shape and in talking with engineers, Danisch saw potential for his technology to measure the shape of soil and of large structures.

Geologists have been measuring soil shifting for years, using sensors known as in-place inclinometers, which are placed within a borehole, and manual inclinometers that are used to manually scan the borehole. Inclinometers essentially measure tilt, with each inclinometer measuring tilt in one place along the length of the borehole. However, there are limitations to the technology because if the inclinometer is not placed at the proper depth it will fail to measure movement in the soil. Manually scanning a borehole involves lowering an inclinometer and stopping it every few feet to take a measurement. Despite the drawbacks of conventional inclinometers, they have been the only choice for geotechnical measurements for years. With the conventional inclinometer method, small construction projects would have workers using inclinometers to manually scan dozens of boreholes while dozens of other boreholes would be monitored with in-place inclinometers. Larger projects such dams, bridges, and excavations in urban areas have hundreds of instrumented boreholes and inclinometers.

In 2005, using ShapeTape™'s 3D math as his base, Danisch invented a new sensor, ShapeAccelArray™ (SAA). Initially, most Measurand employees thought ShapeTape™ was the wrong product for this application. Designed for use indoors on a human body, used outdoors on the ground, ShapeTape™ would drift, producing invalid readings. The environment also proved too cold, too hot and too wet. The ShapeAccelArray™, had sensors which did not use optical fibre, but tiny MicroElectroMechanical sensors (MEMS) that were immune to harsh environments. The ShapeAccelArray™ eliminated the need for manually measuring all these boreholes. It is an array of sensors up to 120 feet long that is lowered into a borehole and left there to make the measurements. Unlike inclinometers, the ShapeAccelArray™ has sensors every foot, so will be unlikely to miss shifting soil. Also unlike inclinometers, the engineer does not have to visit the site. ShapeAccelArray™ will send the data automatically to the user's desktop computer.

Danisch viewed the worldwide construction industry as Measurand's greatest opportunity for growth. As with its initial motion capture system, Measurand could position itself within a niche area of this larger industry: soil and civic structure monitoring. This niche sector grew as countries experienced increased urbanization that in some places, such as Dubai, Mumbai and much of China, was explosive. Enhanced public safety regulation and an increasingly litigious environment made it an essential business practice for construction sites to increase environmental monitoring.

Measurand in 2009

In 2009, Measurand had 15 employees. Danisch's original employee, Scott Thomson, was vice-president of Measurand. The pair each managed a distinct team, with Thomson overseeing the ShapeWrap hardware and market development and Danisch leading the development of the ShapeAccelArray™. As with many small companies, there was considerable crossover, with the electronics designer and the software developer working on both teams (see **Exhibit** 2).

Measurand had four product lines but sales efforts focused exclusively on ShapeWrap III, the latest model of the ShapeWrap motion capture system, and ShapeAccelArray™. Measurand determined the markets for the other two product lines, ShapeTape™ and ShapeSensor, did not warrant any sales or marketing effort. Overall, exports accounted for 90 per cent of Measurand's sales, with roughly an even split between the United States, Europe and Asia.

ShapeWrap III, the third generation of ShapeWrap, was released in November 2007, directly through Measurand in North America and through distributors in Asia and Europe. Post-secondary education institutions were its primary market; these institutions were interested in inexpensive alternatives to the high-end motion capture systems, now widely regarded as the industry standard for digital animation. In 2009, Measurand's sales efforts for the ShapeWrap III included one trade show, two or three sales trips each year, and an effort to increase ShapeWrap III's online presence; this reflected a reduced sales budget for Shape Wrap III so that time and money could be redirected to the ShapeAccelArray™.

ShapeAccelArray™ (SAA), Measurand's newest sensor, was greeted with enthusiasm and gained wide acceptance within the geomatics industry. Danisch and the Measurand team believed they would eventually see a significant and rapid growth in sales. Danisch's ShapeAccelArray™ team embarked on a significant sales effort in 2008 that included many geological conferences and trade shows over a 12-month period. Measurand began installing ShapeAccelArray™ and in one of its earliest installations ShapeAccelArray™ measured one inch of soil movement next to a highway. As a result, the highway was closed and three days later a portion of the road dropped nine feet. This helped secure ShapeAccelArray™'s position as Measurand's most successful product.

Challenges for the Future

In 2009, Measurand needed to address a number of significant challenges. First and foremost, an increasing number of competitors within the motion capture market and a strong Canadian currency forced Measurand to adjust sales forecasts. Measurand priced its products in American dollars and the dollar's decline significantly reduced Measurand's income; the company could not increase prices to overcome the over 25 per cent decline in the U.S. dollar compared to the Canadian dollar from 2005-2008.

The loss of two significant partners, Northern Digital and Siemens, impacted Measurand's revenue forecasts and was compounded by a reduction in research funding. Cumulatively, these factors produced a stagnant revenue base between 2004 and 2007, despite increased sensor sales (Exhibits 3 and 4). Measurand's income base had anticipated a reduction in its NRC funding. Because Danisch was not undertaking any new research, Measurand was unable to access NRC funding, which has averaged about $200,000 annually between 2001 and 2007.

Historically, Measurand was unsuccessful at raising capital through private investment and after a string of presentations failed to generate interest from potential investors, Danisch and Thomson decided to devote their time to product and sales development. Despite increased sales, Measurand recorded a $130,000 loss in 2008 and 2009 forecasts predicted a similar result due to a lack of anticipated project or license income. Danisch and Thomson decided to reduce costs to avoid another deficit. Initially they considered non-salary cuts but that would have resulted in only $20,000 in savings. The pair made the difficult decision to layoff one of their managers. Danish explained:

> *This was a tough choice but it came down to whose job is easiest to divide among the rest. Knowing the risk of losing an experienced salesperson and the difficulty of dividing the sales effort, I decided this was the least painful course of action to reduce salaries. While it may seem wrong to remove the only salesman when sales are declining, but there were reasons. This seemed like a good idea. The sales effort for ShapeWrap was reactive and declining in favour of ShapeAccelArray™. ShapeAccelArray™ was not taking off as fast as everyone at Measurand thought it would and the sales effort was already shared by the ShapeAccelArray™ team. I thought the additional sales effort required after the shows could also be shared by the SAA team.*

The lay-off of Measurand's sales director precipitated a conversation among the remaining staff about succession and human resources development at the small company. As Thomson outlined, Measurand would lose three key things if Danisch retired with no clear ideas-generating successor in place. "If you look at the history of Measurand, someone had to bring the ideas, the original ideas, to the table," he said, explaining that while everyone participated in the development of all of Measurand's products, the initial idea always came from Danisch. Thomson further explained, "New ideas are what drives this company and keeps it competitive. There are many people at Measurand that can develop and improve, but there is only one person with original ideas."

GLOSSARY

3D – 3 Dimensional

CSA – Canadian Space Agency

IPI – In-place inclinometers – sensors that measure the same thing as ShapeAccelArray™ except only in one place. SAA could almost be considered an array of in-place inclinometers.

MEMS – micro-machined electromechanical systems is the integration of mechanical elements, sensors, actuators, and electronics on a common silicon substrate through micro-fabrication technology. While the electronics are fabricated using integrated circuit (IC) process sequences (e.g., CMOS, Bipolar, or BICMOS processes), the micromechanical components are fabricated using compatible "micromachining" processes that selectively etch away parts of the silicon wafer or add new structural layers to form the mechanical and electromechanical devices http://www.memsnet.org

MRI - Magnetic Resonant Imaging uses a very strong magnetic field to produce a three dimensional image of inside the body.

PTL – Process Technology Limited, a semiconductor manufacture in Fredericton, New Brunswick, Canada. Danisch was Vice President from 1884 to 1986.

RPC – Research and Productivity Council research agency where Danisch was the head of the the Electronics Department from 1986 to 1993. RPC was an independent contract R&D and technical services organization located in Fredericton, NB. that provided analytical chemistry and material-testing services, prototype design, manufacture and testing services and had a wide variety of pilot facilities for the development and improvement of industrial and environmental processes and products.

SAA – ShapeAccelArray™ **-** an array of sensors that measure the shape of soil in areas such as landslides, construction sites or on structures.

SAA3D – ShapeAccelArray™ software used to visualize the data from the sensors.

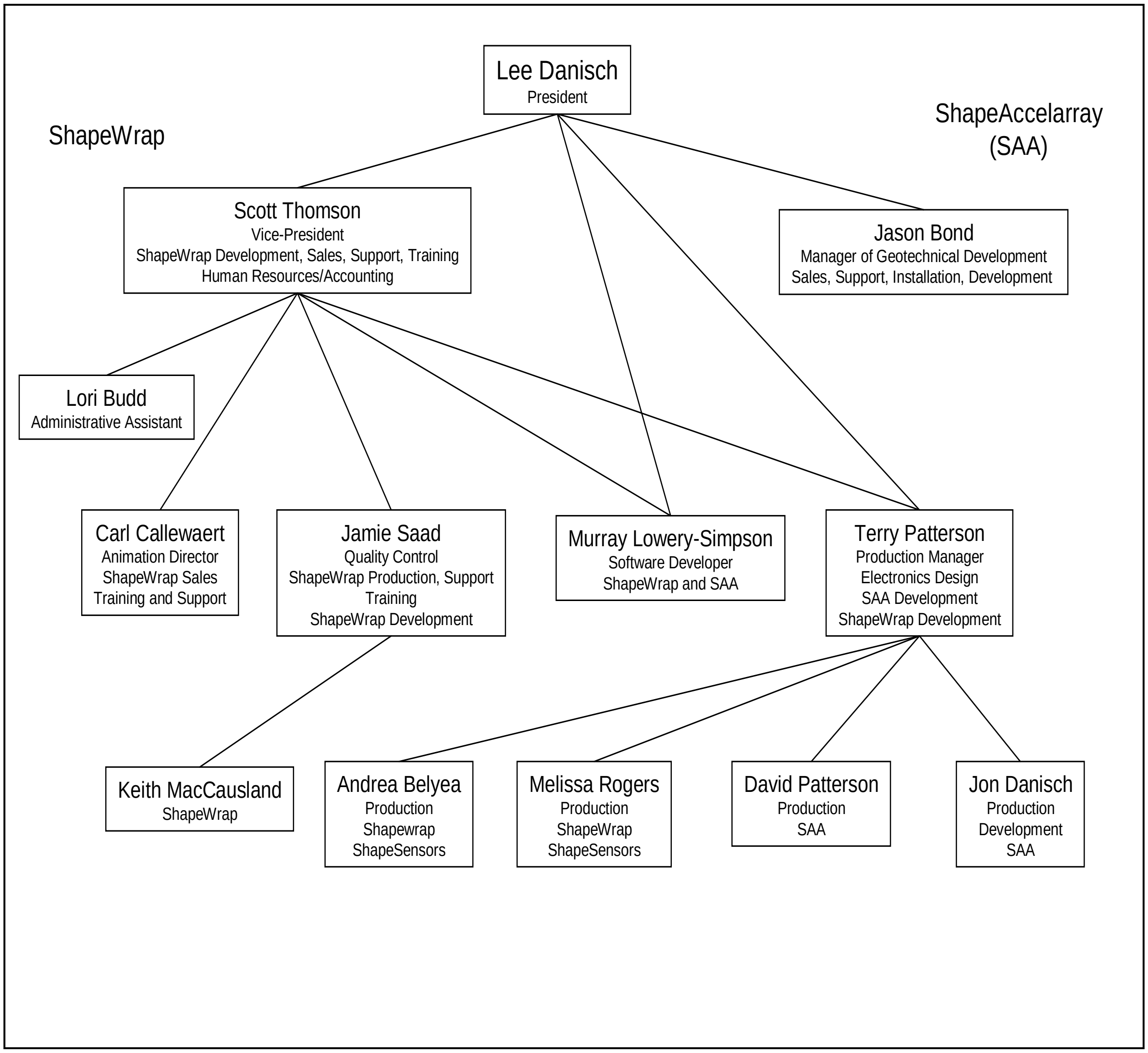
SI – Slope Inclinometer – generally a sensor (inclinometer) that is manually put down a hole and stopped every 2 or 3 feet to measure the slope of the hole at that point. By stopping every 2 or 3 feet one can map out the slope change for the whole length of the hole.

Source: Case Writer

Exhibit 1: Map Boston to Fredericton

Source: Google Earth

Exhibit 2: Measurand Organizational Chart



Source: Measurand Inc.

Exhibit 3: Measurand Balance Sheet, 2006-2008

Measurand Inc			
Balance Sheet			
Year Ended April 30			
	2008	2007	2006
Assets			
Current Assets			
Cash	68,696	191,861	378,742
A/R	267,960	203,323	281,677
HST Rec	26,613	40,764	0
Advances to S/H	5,675	0	58,359
Tax Rec	200,960	206,680	205,084
Inventory	107,849	19,572	5,528
Prepaid	7,056	8,670	0
	684,809	670,870	929,390
Equipment	25,882	27,359	36,042
Patent Rights	38,741	21,624	16,781
Advances to Related Company	71,486	112,534	150,878
Incorporation Costs	794	794	794
	821,712	833,181	1,133,885
Liabilities and Shareholders' Equity			
Current liabilities			
Accounts payable and accrued liabilities	177,822	59,231	37,580
Current portion of long-term debt	76,833	79,644	79,643
Advances from shareholders	0	497	0
	254,655	139,372	117,223
Long-term debt	558,762	547,701	637,225
Shareholders' equity			
Shared capital	320,050	320,050	320,050
Retained earnings (deficit)	(311,755)	(173,942)	59,387
	8,295	146,108	379,437
	821,712	833,181	1,133,885

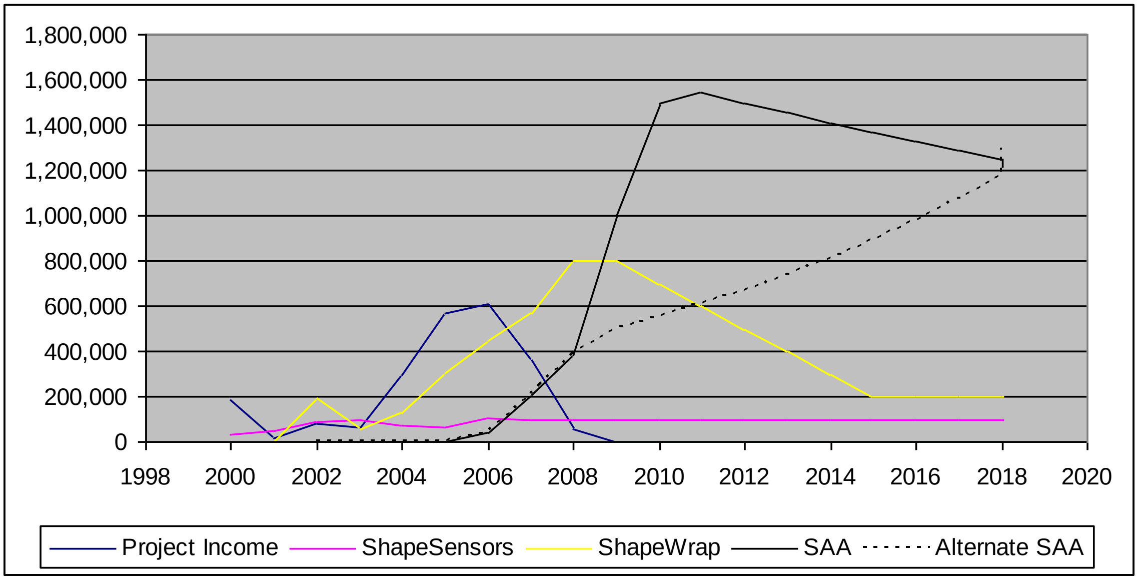
Source: Measurand Inc.

Exhibit 4: Measurand Income Statement, 2006- 2008

Measurand Inc			
Statement of Income and Expenses			
Year Ended April 30			
	2008	2007	2006
Revenue			
Professional fees	33,706	287,358	545,289
License	37,500	75,000	66,250
Sale of sensors	1,476,270	1,014,590	848,950
	1,547,476	1,376,948	1,460,489
Cost of sales	597,068	495,591	406,636
	950,408	881,357	1,053,853
Expenses			
Advertising and promotion	70,853	26,656	16,561
Automobile	157	882	473
Depreciation	7,391	8,683	11,190
Insurance	11,081	13,759	9,233
Interest and bank charges	2,329	1,025	3,855
Occupancy	95,167	65,333	49,511
Office	21,416	17,748	18,955
Professional services	22,881	11,166	19,553
R&D Material	34,467	0	0
R&D tax credit	(200,000)	(206,680)	(205,084)
Salaries and benefits	873,222	1,070,441	690,522
Subcontract	6,480	0	0
Telephone	7,708	7,397	8,388
Travel	135,069	98,276	108,059
	1,088,221	1,114,686	731,216
Net earnings (loss) for the year	(137,813)	(233,329)	322,637
Retained earnings (deficit), beginning of year	(173,942)	59,387	(263,250)
Retained earnings (deficit), end of year	(311,755)	(173,942)	59,387

Source: Measurand Inc.

Exhibit 5: Estimated Product Lifecycle



Source: Measurand Inc.