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Q&A with Dr. Stephen Horowitz, PhD, President of IC2, a company developing, manufacturing and selling sensors for the aerospace industry including Aeroacoustic Microphones, Shear Stress Sensors and Pressure Sensors

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CEOCFO: ***Dr. Horowitz, would you tell us the idea behind IC2?***
Mr. Horwitz: Our company specializes in developing, manufacturing and selling sensors for the aerospace industry. We are targeting measurements for aerodynamics and aeroacoustics to engineers and scientists who are designing, building and researching aircraft and how to make them more efficient and quieter and things like that. We are in the business of improving the sensors that they can use.

CEOCFO: ***What are some of the challenges unique to the industry, where you are able to provide a difference?***
Mr. Horowitz: There are a couple different types of challenges. On the technical side it is a pretty tough measurement environment. Often folks are measuring things in wind tunnels and sometimes those are at high speeds, high temperatures, there is a lot of vibration, and a lot of noise in the environment. That is one of the requirements on the sensors, that they handle that type of environment and perform well. When we build our sensors, we are trying to improve performance compared to existing products and we succeed at that but it is challenging because we are up against these constraints of having to survive and do well in that type of environment. Then on the businesses side there are a lot of niche markets where you have small groups of scientists that are studying one type of phenomenon and need a sensor that performs a certain way. Another group needs a slight variance of that sensor because they are studying a different aspect of the science or designing a different vehicle, so you cannot design one sensor for all approaches because you will not be able to give them the kind of benefits that they each need for their own requirements.

CEOCFO: ***How would you engage with a company?***
Mr. Horowitz: We originally got our start working with government customers doing what is known as SBIRs and STTRs. These are research and development contracts to advance the product and there are customers within the government who are the end users. There are folks who want the end product, the sensors, to be able to use for their testing and we are using this SBIR program to enable that. Sometimes there are set requirements that come from the government, where they have a specific need. In other cases, it is more open-ended and more like improving upon the current state-of-the-art, address the open challenges, and make something better than what is out there, but in terms of actual requirements sometimes it is a little flexible. That is how we got our start. We have since moved into and grown into working with commercial industry, and there are a couple different market segments. There are the aviation or aerospace industry companies and many of these are big companies though some of them are smaller. There are universities that are doing basic science and research in aerodynamics. Because of that, we have to address them each a bit differently. For the companies, sometimes they have some very specific requirements so we will do custom development for that. In some

cases, we have something similar and we can adapt the packaging on the back-end of it, taking a sensor that we have already built and customize it slightly. Oftentimes it ends up being a co-development effort where we work together and partner and, in some cases, we go after third party funding like an SBIR program together. In those cases, we get the guidance and support of the industry partner.

CEOCFO: ***How does the hardware and software come together?***
Mr. Horowitz: We do occasional full hardware and software systems, but a lot of what we have built is strictly hardware based. Even in that kind of situation we have parts of the hardware where it can be directly off the shelf and then other parts of that hardware will be customized. Our sensors are built using a micromachining approach. They are what is known as MEMS or Microelectromechanical Systems. It is like the technology that is used to produce integrated circuits on silicon wafers, only we are making moving parts and sensors out of them and so they are interacting in the physical world but are using a lot of the same tools that you would use for integrated circuits. Because of that, we batch fabricate hundreds or thousands at a time using this process, and that make take a certain fixed long period of time and a certain fixed amount of money to get that batch of sensors made but when we are done we have the entire batch produced with several thousand sensors ready to be packaged at that point. That is where we have sort of an off-the-shelf aspect to the system. There is the sensing head, which is also the most critical part of the sensor and that has been optimized and designed. Within that batch we may make a few variants so we may meet different applications, so customer A wants design 1 and customer B wants design 2. We can hit a range of performance requirements that way. When someone comes and they want a sensor, we can take one of those sensors and package it up specifically for that. We have some standard ways that we package and we may have some of those off-the-shelf but oftentimes they have a specific device, or test model for a wind tunnel they need to fit inside of and then we would optimize the packaging to fit their specific application.

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CEOCFO: ***Is it relatively straightforward to understand the environment in which a particular sensor will be used?***
Mr. Horowitz: These environments are fairly well understood. For example, often times they have had a wind tunnel up and running for ten years or longer. They know how it works and have already measured some things about it, so they know it is going to change temperature during a run and there will be a shockwave pressure that will hit of a certain magnitude and certain frequency. They will have some information often about that. They may not have every bit of information that we would like to know but oftentimes they do have something close to that. Sometimes we encounter new surprises when we get into it, like for instance they were using some particular piece of equipment that generates large amount of noise and they did not know. We will add additional shielding and do things to that sensor, so that it is immune to whatever additional noise as necessary. Usually, though, it is things that they know fairly well and they will know what to expect. Right now, all of our applications are ground-based wind tunnel testing applications. We do have some products though in the works that are for flight test and that will have its own set of environment challenges.

CEOCFO: ***Would you tell us about the micro sensors to directly measure shear stress in wind tunnels, which is an industry breakthrough?***
Mr. Horowitz: For many years folks have had to take measurements of something else, like to measure heat transfer. They could not actually measure the shear stress. They measure something else like heat and then through a series of calculations they are able to estimate how much shear stress is incident on a test model in a wind tunnel. I would be good to explain here what shear stress is. Shear stress is similar to pressure only its directed along a surface, tangentially, instead of into the surface. It is a force per unit area, like pressure, only it is a lot harder to measure than pressure because it is not pushing directly into a surface. It is arises in our applications from air flow over a surface, and the frictional forces or drag that occurs on that surface. Our sensors were produced to measure that shear stress.

CEOCFO: ***What is the competitive landscape; are there many companies that work in this arena?***
Mr. Horowitz: No not really. There are a couple of companies that have designed and developed shear stress sensors for very specific chemical application, like in a pipe, industrial measurements. They do not measure fast changes in shear stress, just slow changes. They are not suitable for wind tunnel use because they do not have the performance characteristics that are needed. There are companies who produce sensors that do not make direct measurements; instead they are making a hot wire probe or hot film probe. It is an indirect measurement, they are measuring heat transfer and they are trying to estimate shear stress from that. It is great for certain applications where you actually want to know the heat transfer, but not so useful for accurate measurements of shear stress.

CEOCFO: ***What are the other areas?***
Mr. Horowitz: The other main areas that we focus on are pressure sensors and microphones. There are many companies that produce microphones and there a lot of pressure sensors out there. We are coming at it from a different angle then all of them to provide benefits that they cannot. Those products are about a year out, maybe two years out.

CEOCFO: ***How do you spend your time as president of IC2?***
Mr. Horowitz: I do not do as much technical work as I used to. I still do some design and optimization, whereas I used to also do fabrication and testing. I still occasionally get my hands on stuff but a lot of the time my focus is on running the company and trying to bring in new funding via research proposals. I try to align our product strategy and marketing and getting the word out about our products, and then working at an administrative level, running the company. The majority of my day really is on business development or administrative matters.