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"Flight Rules for Powertrain Planning"

Adriane Brown, President and CEO
Transportation Systems
Honeywell International

Thanks for the kind introduction.

It's a pleasure to be here, particularly as we celebrate the 40th anniversary of the Management Briefing Seminars. As it turns out, we're celebrating an anniversary of our own. Fifty years ago Honeywell provided its first turbocharger to Caterpillar for its D9 tractor…now we produce close to 10 million turbos a year for a range of auto and truck applications around the world.

During the 90s I had the privilege of running the automotive business at Corning. After that I spent six years in Honeywell's Aerospace business before returning to my roots to lead Honeywell Transportation Systems.

I mention my time in aerospace because I think it is relevant to our theme "Is there calm after the storm?" As you well know, aerospace has seen its share of turmoil, particularly following the terrorist attacks of 9/11. That tragedy and its aftermath wasn't so much a storm as a Class Four hurricane.

After weathering the Aerospace storm, I felt I could do just about anything; and when I had the opportunity to return to the automotive industry, I thought, "Bring it on!"

But you know what? After re-examining some of the issues in today's auto industry, rising material and retiree costs, intense competition, chronic overcapacity…I knew that my times spent dealing with the aerospace storm would be a helpful experience.

And I come bringing good news from my former colleagues in the aerospace industry…they would tell you today that "yes, there *is* a calm after the storm."

In any event, I was delighted to take the reins of Honeywell Transportation Systems, which was growing at a double digit clip, in large part by helping to create the European turbo diesel wave.

Diesels swept Europe over the last 10 years with the help of two technologies: the variable geometry turbocharger—which Honeywell pioneered—and high-pressure fuel injection. These technologies enabled diesel performance to match or exceed gasoline performance—except that diesel does it with a 20 to 40 percent increase in fuel economy.

Never before had any business been built on so much hot air, much less a Dow 30 component like Honeywell. Diesels, as you know, need copious amounts of air—to the tune of 20,000 parts air to one part fuel.

Honeywell's unique ability to provide air on demand is no accident, given our role as one of four premier manufacturers of jet engines. Turbos are, after all, miniature jet turbines, so it's fair to say that the aerospace industry helped boost the success of diesel.

One advantage of spending time in another industry is that it gives you the opportunity to look at situations in new ways. When I joined aerospace, I felt there was a lot that industry could learn from the automotive world, such as faster cycle times, lean manufacturing and cost productivity.

And as I recently went through the strategic planning process for our turbo business, I was stuck by how much business planning is like navigating an airplane.

When pilots begin training, they learn visual flight rules, or VFR. This means visibility must be at least 3 miles and you must fly no higher than 18,000 feet.

Beginning pilots learn to navigate under VFR through "dead reckoning." Dead reckoning is the process of estimating your position by using course, speed, time and distance to be traveled. It requires visual clues and the pilot must continually *validate* the course and make adjustments as needed.

Under the right conditions, VFR works well and is easy to understand and learn. Perhaps that's why business leaders often use the principle of dead reckoning to understand where they are and how to get where they want to go.

But plotting a course based on dead reckoning is not always enough since it relies on conditions remaining constant. Of course, as business leaders, we all know that conditions *never* remain constant.

Reluctance to validate our course and accept the rate and scope of change is an age-old problem. Here's what the *New York Times* said at the dawn of the television era.

"The problem with television," they noted, "is that people must sit and keep their eyes glued to a screen; the average American family hasn't time for it."

Try to tell that to my seven-year old daughter the next time that *Sponge Bob Square Pants* comes on…

Sometimes we simply don't see what's possible. While under the right conditions VFR may get you safely to your destination, you may find that where you landed is not precisely where you needed to be.

So let's say you want to fly when minimum visibility rules aren't met. Pilots then need to fly by IFR or instrument flight rules.

Under IFR, navigation can be unsettling. Pilots talk of "vertigo" when their brain tells them one thing but their instruments tell them something else. It requires a leap of faith. They learn to trust those instruments and comprehend reality in a new way. Intuition and "feel" are secondary to data and facts.

Accepting reality—even when it is contrary to your prior experience—is a necessity for both pilots and business leaders.

It's important to note that flying under IFR is not the same as operating on autopilot. It takes a skilled pilot to monitor and interpret the data from his or her instruments and to deal with changing conditions. Similarly, it takes capable business leaders to assess the input from multiple sources and use that information to plot a course for the future.

Of course, we don't have airspeed and horizontal indicators in the automotive industry. So what instruments do we use? We all monitor worldwide macro economic trends, government regulations, emissions legislation, technology breakthroughs, and consumer behavior and preferences.

These are the "instruments" we rely on as we work to answer the following question: How will the powertrain of the future play out around the world in the next five to 20 years?

From analyzing our instruments, the data collected has led me to three general principles for powertrain planning.

 # 1: For the foreseeable future, internal combustion engines will continue to develop and grow.

Let's go back to our comparison with television. When the *New York Times* wrote its review, televisions were black and white. Next, they went color and now they're going high definition. But even though our flat panel plasma screens look different than the console sets we grew up with, TV still dominates just about everyone's home.

Similarly, no one is predicting the demise of the internal combustion engine. But what forms will they take? How about turbo diesel? Hybrids? Will fuel cells take over some day? There are many instruments to observe here.

On the question of diesels, J.D. Power's cockpit is forecasting that the U.S. turbo diesel segment will grow to 7.5 percent by 2012. The instruments in Ricardo's cockpit are showing even more bullish data.

J.D. Power also forecast hybrids increasing to 3.5 percent market share by 2012—less than half of their diesel prediction. If we were only watching *Entertainment Tonight* or reading some of the national newspapers, you'd think that we'd all be driving small hybrids along with Leonardo DiCaprio and Cameron Diaz. Or at least that would be the impression if you were operating under *visual* flight rules.

Our cockpit also indicates diesels will maintain their efficiency advantage over gas, but vastly improve in performance, partly due to some advanced turbo technologies. 100 horsepower per liter and 140 foot pounds of torque per liter will be the norm within a few years.

On the gasoline side, all instruments are pointing to combining turbocharging with direct injection, similar to what is used in the diesel world. Gasoline combustion will become more complete, cleaner and more efficient.

#2: Tomorrow's powertrain technology will vary; their need for air will not.

In aerospace, we have seen a growing diversity in aircraft. While flying was once dominated by large commercial airplanes, we've seen the development of regional jets, business aircraft and even the promise of "micro-jets" that are transforming how people move from place to place. Imagine the concept of "air taxis."

Similarly, we will see the adoption of more variety in our powertrain choices—all of which will need air. We know that gas and diesel engines need lots of air, and many will use turbochargers, but so do hybrids and the fuel cells that will be available. As emissions and fuel economy regulations become more stringent, precise and powerful air delivery will become more important—for all IC platforms.

By the way, it's interesting to note the energy bill the House passed last week includes tax credits for *all* of those technologies.

I am very respectful of hybrids, which are currently the cleanest mainstream powertrain around, although there are still many unanswered questions. Not only are hybrids a great technology, but you have to give credit to the companies that set their sights on this breakthrough technology. They flew by instruments and *sheer will* to engineer a new kind of powertrain.

And yet, the innovation and breadth of thinking can go even deeper. Just think…if a diesel engine is more efficient than a gas engine and some hybrids can get even better economy than a diesel, it sure makes a case for a *turbo diesel* hybrid as one of the next powertrain solutions.

We're heartened by the fact that DaimlerChrysler, GM and others have already begun development of turbo diesel hybrid powertrains.

For propulsion technologies like fuel cells that may have diminished exhaust energy, emerging turbo technologies such as Honeywell's e-Turbo™—which will use an electric motor to bring the turbo to speed—could supply the necessary air even at very low operating speeds.

Which leads me to my third principle. . .

Innovate for results, not for the sake of innovation.

After having been in the turbo business for 50 years, we've learned that innovation only matters when it delivers results. Innovation must do two things to really count: deliver the *benefits* and the *value* that customers want.

If an innovation meets that criteria, even when it is ahead of the market, it can be "market making." Fifteen years ago, the greatest barrier for Honeywell on the diesel side of our business was the *performance* of the technology itself.

Before the 1991 Fiat Croma, diesels weren't competitive with gasoline engines on performance. Truth be told, they were slow, smoky and noisy. The inherent benefits were there, but the technologies weren't ready. If you were operating under VFR, you would have ruled out diesels as any sort of practical future powertrain.

But a few companies helped *create* the market by enabling diesels to exceed gasoline performance with substantial fuel economy improvements. As this group well knows, the performance and fuel economy characteristics of a turbo diesel are breath taking.

And for those of you that haven't had first hand experience with some of the vehicles, come join us in the parking lot where Honeywell has a production SUV that makes 550 foot-pounds of torque, does 0-60 in just over 7 seconds *and* delivers 23 mile per gallon. The first time I stepped on that accelerator I thought, "Why can't *all* SUVs launch that way?"

While the performance of turbo diesels can be awe-inspiring, the challenge is cost. As you can imagine, an *überdiesel* using two turbos—or four in the case of a V engine—isn't an easy cost pill to swallow. Packaging is a challenge as well. So we are *innovating* to push the benefits of two turbos on *one* shaft.

On current production variable geometry turbos, we control the flow of air by manipulating the vanes on the turbine side of the turbo to reduce lag and improve drivability. Now we are developing variable vanes for the turbine and the *compressor* wheel.

We call it the Variable Geometry Compressor, or VGC, and it gives drivers 10 percent more power, 20 percent more torque and 700 more rpm than today's state-of-the-art variable geometry turbodiesel. Its first application will be on the road in Europe shortly…

The next trick will be to bring variable geometry to gasoline. It's not easy given the higher temperatures of gas engines. But we are working with our aerospace colleagues at Honeywell to develop high performance alloys that are affordable for automotive use.

What innovations will we see in the future? Perhaps it will be comprehensive air management systems that can reduce diesel emissions much more efficiently than today.

And what about the promise of gas-to-liquid fuel technologies that can create diesel fuel so clean that it contains *zero* sulfur?

I'd like to say that all of us in this industry need to learn how to be able to read the instruments in our own cockpits. We can't operate on auto-pilot and we must be acutely aware of the environment around us.

And like pilots struggling with vertigo, we have to sort out the difference between what we *feel* from what is reality—even if that means breaking a few rules that reflect the comfort zone of more than a century of reliance on the internal combustion engine.

So where do we fly next? And *is* there a calm after the storm? As an industry, we are already on that journey. There are many ways we can get there, but flying by the seat of our pants is not one of them.

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