On the 100<sup>th</sup> anniversary of Aviation Week magazine, they asked me to write an OpEd to answer two questions:
What are the most important technologies that aerospace should pursue?  What are the most promising technologies that might be overlooked?
The following was published by AvWeek in May 2016.

My addiction to AvWeek started over 50 years ago. During my seven years of military flight-testing at Edwards Air Force Base, AvWeek was our best source of aerospace information.  We read every issue thoroughly and kept them stacked on our desks for reference.  Chief Editor Robert Hotz not only reported the raw aerospace facts - his editorials were the war-fighter's political grist.  I recall shouting "Bob Hotz for president" while reading his editorial during the 1968 campaign.

On the 100<sup>th</sup> anniversary of the Wright brother's flight, AvWeek asked me for comments. I identified nine individuals I thought were most responsible for the progress of the first 100 years of flight.  Interestingly, I later discovered that all of them had been young children during that incredible four-year period starting in 1908 when Wilbur Wright flew his airplane in Paris.  By 1912 there were aircraft being flown in 39 countries and factories in Europe building 500+ aircraft per year!

When youngsters (age 4 through 16) observe extreme progress, they later as adults, exercise the "three Cs" (Curiosity, Creativity and Courage). This enables the technical breakthroughs so important to human progress.

Why the worldwide surge in airplane development in only 4 years? Man had been Curious all along, but it was the Courage to try that energized the world's Creative minds (hey, if bicycle shop guys can do it, I can do it too).

Further evidence:  Almost all the billionaires that now provide our breakthroughs in commercial space were ages 4 through 16 while observing the incredible 1960s when the world developed nine

different rocket launch systems that flew humans to space in only nine years.  Subsequently, only three new human launch systems were flown in the next 46 years. Is it possible that this lack of progress is because there has not been a surge of exciting new capabilities to motivate young people?

Four Observations:
One - successful innovators aggressively practice the 'three Cs' because, as children, they concluded that impossible achievements are not just possible, but expected.
Two - advances in technology do not happen at a linear rate. Short segments of phenomenal progress are scattered among decades of boredom.
Three - innovators can achieve far more than what most people think is possible.
Four – most technical breakthroughs happen because individuals work to achieve **personal goals**, not because governments provide funding.

With this in mind, what are the most important technologies that aerospace should pursue?  What are the most promising technologies that might be overlooked?

Research, as opposed to Development, requires a goal that most people think is impossible to achieve. You cannot encourage progress on Research breakthroughs yet to be discovered. Could we have encouraged invention of today's Internet in 1980?

Let's try anyway.

We should aggressively try to find if we are the only intelligent species in the universe. Everyone has this curiosity (the first 'C'). I would love to see innovators attack the question with the other two 'Cs'. I believe that my lifetime has included the most interesting period of human history. However, if I miss our discovery of ET, then my belief will definitely be wrong.

I agree with my friend Elon Musk that locating our species on more

than just earth may be our most important engineering challenge. Also, protecting our earth and our species from history's only real/significant threat (asteroid/comet impact) should not be overlooked. Aerospace researchers should have a critical role in developing technologies needed to achieve both those goals.

In the mid-60s, when we were in a four-country race to develop SST capability, it seemed a logical jump forward – a similar step to the advent of jet airliners just 11 years earlier. The only SST put into service was the Concorde.  It was in service an entire life cycle with no intermediate improvements in efficiency, noise or performance. That is because it never had competition. Thus, its excitement decreased during the entire 27 years.

I now do not think developing supersonic personal transportation is important.  We will soon have realistic virtual reality so the business exec can feel the nuances of a handshake while signing the big contract without enduring the airplane ride. His competition, flying in a supersonic jet, will get beat by several hours. Also, the general public will soon experience unlimited, low-cost vacations to exotic and newly discovered locations using impressive VR that will improve every year.

Education is our most overlooked technical problem. Our current standardized, regulated classroom environment is a failure. After the Apollo moon landings America was first in awarding advanced degrees in math/engineering/sciences to its citizens. Now, we don't even show up on the first page. We must strive to nurture in our children the Curiosity, Creativity and Courage that took us to the moon and to restore our lost sense of exceptionality. The big public education experiment has failed America and cannot be fixed just by throwing more money at it. We need to apply the three 'Cs' to the problem with a clear goal of regaining our number one status. This effort requires the best talent within the Aerospace industry. Reaching this goal might save the world.

Those who defend the current education system will ask what the new breakthroughs will look like. We do not know. We did not know

what the Internet, GPS and DNA looked like before they were recognized as breakthroughs. But that should not stop us from seeking the needed breakthroughs.

Any important breakthrough, before it happens, is often scoffed as nonsense. Thus, those who find the breakthroughs need to have 'confidence in nonsense'.  Thus, successful innovators tend to look more like idiots than the 'sensible, straight-A students' who spend their careers being careful to never fail. The 'sensible' never think about the importance of the third 'C'.