



Thinking Outside the Oval

This series features innovators from outside of Ford who are willing to share their ideas, methods, and processes to help spark innovation. These thought leaders recognize the importance of learning from and sharing with each other.

This installment features Sanjay Dhall, president and founder of Detroit Flying Cars, which is developing a uniquely more flexible form of transportation, bridging the divide between road and air. It is currently in the midst of developing a concept prototype of its first generation flying car. Sanjay is also founder of Emergent Systems, a product design and engineering company. He is also an avid pilot, who flies an airplane he built in his garage. [\[Read related profile.\]](#)



Please tell us what you do and how it relates to innovation.

I like to think of myself as an inventor engineer artist. I love to design clever new things, to solve interesting design and engineering problems, and look for beauty and simplicity in products and ideas. For the past several years I have been in the midst of designing and building a flying car, a machine that will drive comfortably on the road, then transform easily to an airplane and be able to fly long distances. **Detroit Flying Cars** is the company built around this mission.

For my day job, I run **Emergent Systems, a new products design and engineering company**, which until recently was based in Dearborn, Mich. Ideas on innovation, invention and creativity have been foundational in Emergent Systems' work, leading to many patented products for our customers. **Auros Knowledge Systems**, an Emergent Systems-affiliated company may be better known to engineering personnel at Ford Motor Company, as our Auros/E2KS software is used by many people at Ford Motor.

Long before “fake news” was a common phrase, Auros/E2KS was implementing confidence metrics for knowledge!

I have dreamed of flying as long as I can remember. Growing up in India, amid throngs of people, inspired in me a general sense and desire for open spaces and physical freedom without bumping into others.

Seeing an open field always made me happy. I craved open spaces where I could fly my little model airplanes. Coming to the U.S., I experienced the wide-open spaces of the rural Midwest. It was heaven to me. One of my first trips after acquiring my first car, an old beat up Chevy Monza, was an inspiring visit to **Wright Patterson Aircraft Museum** in Dayton, Ohio, which is the hometown of the Wright brothers. I resumed designing, building and flying model airplanes with great vigor. The urge to fly above and see these beautiful, open landscapes from the sky led me into hang gliders and ultralight airplanes.

But I dreamed bigger. I initially had dreams of flying my own full-size airplane. A visit to the **Oshkosh Airventure Airshow** shortly after coming to the U.S. opened my eyes to the possibility of building my own airplane. Building a plane gave me the confidence and wherewithal to face my **ultimate dream of designing and building a flying car.**

Time passed. Building a career, being busy at work and raising a family took center stage. But the germ of the idea to build a flying car persisted. About a decade ago, I began to consider how the flying car would actually work, so I laid out the general specifications of the machine. It must drive easily on the road, then transform into an airplane, and fly reasonable distances. And it must fit in a normal American single car garage. On the road the flying surfaces must disappear and not be a distraction while driving. That was a start.

I regularly asked myself how I could achieve such transformation. I continued to dwell on possible solutions. About seven years ago, while running on my treadmill, the idea popped that the transition could be achieved using a system of telescoping wings with many sections that neatly slide within each other.

This has the benefits of enormous space-saving efficiency. I built many models to test this idea. I continued to develop this approach to a more practical solution, where the number of panels



kept to a minimum. This presented an insurmountable challenge. Over the next few weeks I pondered this impassable hurdle.

Then, once again, while running, an idea presented itself which at first blush seemed ridiculous! What if the wings were not in line, but stacked one above the other, like a pile of books on a table. But that would make the flying car non-symmetric. Surely, such a machine couldn't fly! I let the problem simmer in my head for quite some time, then considered that nature may not care about symmetry as we humans might.

Nature may not care about straight lines, squares or circles. When I looked out of the window in the backyard, I was looking at our tree, with its trunk not quite upright, nor the branches particularly straight. This was reassuring, but not conclusive. But I do trust nature. I had an engineer at my company perform a computer simulation using CFD (to study the behavior of airflow over the non-symmetric wings). No dice. The analysis showed the machine would not work. Another rejection! It was over. Over the next few days I nursed my wounds. Then it dawned on me. I had missed something very simple! One small tweak, then we reran the analysis, and it worked beautifully. Nature helped me find the missing link! Numerous patents have followed. We were off and running!

Describe your creative process. For example, how do you come up with ideas like this? Are you the kind of person who juggles lots of ideas and tests them as you go, or do you focus one and fully develop it first?

My general philosophy on innovation goes like this: life is not a race, it's a scavenger hunt or a treasure hunt. The rat race of life is a myth that is unknowingly perpetrated by us all. But in reality we are all unique, we possess unique gifts and skills, motivations and desires. As with a treasure hunt, we seek to gather prizes by looking for them in hidden places. Looking in places where others have been is unlikely to yield meaningful treasures. We are successful only when we look in place where others haven't looked. This necessarily means we have to capitalize on our own uniqueness. Searching this unique path through life will lead to treasures we pick up along the way, making for a fulfilled existence.

This scavenger hunt mindset drives me to seek the pennies along my own path, not that of others, envious though I may be. I also believe that pennies lie everywhere, and in every



pathway. However, it does require that we are observant and mindful. Mindful of the world around and within. Observant that our eyes, ears and senses are open to them.

This same openness, mindfulness and observant approach applies to seeking ideas.

First thing to do is to dream. Close your eyes and imagine the world you want to see around you, the world you want to be in. Choose the parts of it that really inspire and excite you. Leave the other parts alone. Trust that there are others who will do their part too. Try to ignore the practical realities of today. Feel free to share your vision; it doesn't hurt to stake your claim to the treasure, though it requires one to be fully committed to the cause.

Then consider ways to achieve that dream. This requires the same mentality of the scavenger hunt. Once we declare our vision, it clears the clutter, and makes pathways visible. It's akin to the exit lights in a jet airliner in an emergency. But now we must be mindful and observant when solutions present themselves, which they surely do. We have to recognize them when they appear. The observant mindset leads to the frequent chant of "could this be the solution?" as we look around.

One of the sources I heavily tap into for inspirations, ideas and solutions is Mother Nature. Nature is a terrific repository of all sorts of ideas. Ideas in a cloud, literally! A wealth of ideas entirely at our disposal, answers all around us waiting to be picked up and harnessed.

To me being creative means having a wider tool chest of ideas. To initially achieve this, I believe we must abandon the ongoing tug of war with creativity on one side and these 5 Cs pulling on the other side. The villains, the 5 Cs, are convention, conformance, compliance, compulsion, and credentials. As we grow up and mature we learn, which enables us to live with fewer accidents as we learn to maneuver and create a pathway.

But this pathway becomes narrower over time, encumbered by life's lessons. These are the 5 Cs. At the time of seeking new ideas, the 5 Cs become a significant hurdle to invention, and shrink the tool chest of possibilities. When being creative, it helps to be able to think like a child, who is simply unfamiliar with the conventions of groups, rules to comply with, not compelled to do the right thing, nor able to conform to protocols of society, nor aware of a credentialed expert. A child simply sees the world as it is, without being filtered through the 5



Cs. Achieving that state, while having the life observations of an adult, enables the opening up of a bigger tool chest of ideas.

But more on the tug of war with the 5 Cs some other time. Stupid and ridiculous ideas always get a higher priority of acceptance in my world. When we come across a silly idea, I like to give it a wide berth, and let it develop, to see how far we can take it to become a practical possibility. Very often such stupid ideas become the heart of the solution. **This has been the case with the flying car.** What seems stupid is sometimes only because we see it through the lens of today's realities, not the new world where the idea or invention will live.

Accidental ideas aren't ignored either. Again the same observant mindset treats each event or sighting with the question, "Could this be the solution?"

What about feedback and comments from others? Our normal tendency is to react poorly to the naysayers. Once again the observant mindset comes in. Seek out the portions of the comments that could be constructive. The trick is to know the difference between a naysayer and a constructive observer. See if there is something to be learned, a lesson to be gleaned.

But in general, keep moving forward. I do not like to be bogged down by excessive analysis, lest the project become victim of "analysis paralysis" and comes to a standstill.

There are generally plenty of great ideas thought up by people. **However, what seems to be in short supply are the doers, the builders, the makers, the triers.** The people who actually take the step to switch from the mind to the hands. This is where the idea takes on physical shape. In my observation, the West, and United States more notably, have produced a sizable number of folks who have been driven to convert their ideas to commercial and practical realities.

Again, in order to achieve momentum, I don't dwell or second-guess solutions for too long. I don't seek perfection. In fact, in my book, perfection is overrated! When I start off, I'm looking for satisfactory. Incremental improvements come later, not now. **But It is imperative that the idea move from the mind to the workshop, and then to the testing grounds in the sand dunes of Kitty Hawk.**

In order to create the new normal, I find that I need to ignore the existence of the present normal. This is the hard part for our minds and takes imagination and a leap of faith.



Breaking free from our normal routines and habits is another avenue to unearth new ideas. Doing unfamiliar things, taking unusual routes, all open up possibilities to observe the world from a new vantage point, exposing us to new ideas.

Innovation, in some ways, requires one to isolate oneself from the normal world and our daily existence. It requires us to challenge what we see as normal. It's an act of rebellion. This is my creative philosophy.

To me innovation is a combination of method and randomness. It sounds contradictory, and it is. I find myself weaving through numerous ideas, many of which lead to dead ends. But then along comes a honey of an idea, that makes all the failures, all the skinned knees, worth it.

Describe how you built your prototype. How big is your team? Did you have any assistance or mentors?

A few years ago with the help of a designer and a couple of engineers at Emergent I was able to develop the basic digital design for the prototype. The engineers have also helped in validating the design using computer simulations. The designer and engineers, as well as several experimental airplane builder friends have assisted me in building the molds, fixtures and the carbon composite components that make up the flying car. A welding expert, and electric vehicle enthusiast, a motorcycle builder, and a nearby machine shop, have also assisted in this endeavor from time to time.

Nature had been a great mentor. I regularly try to read about the lives of inspiring innovators and leaders, to learn from their experiences, challenges, and the way they responded.

What has been the response to your idea?

'This is so cool!' is the typical response when people see it. After that they have lots of questions.

In July 2017 we unveiled our concept prototype at Airventure in Oshkosh Wisconsin. This is among the biggest airshows and aviation gatherings in the world. It was a superb opportunity to get people's reactions.



The prototype received a very positive response from the attendees, journalists, and reporters at the show. The aviation enthusiasts were delighted to see this concept. Many had doubts on account of the absence of symmetry. There were many sceptics too.

It's so funny. Several adults looked at the prototype with puzzlement. Some rolled their eyes. Many expressed doubt whether such a machine could fly. They would often comment about how so many flying cars have been attempted before and failed. which is true. Many came up with lists of reasons it wouldn't work. Some said they had the same idea. But most had questions about regulations, rules, and licenses...

On The Other Hand, a good majority of aviation enthusiasts were positively stoked. A few folks were really impressed and believed this configuration could actually work.

But do you know which group of people embraced the concept of the flying car readily, and without reservation? Kids, all of them!

I work with a lot of really busy engineers who are hearing that it's important for them to innovate. What would you say to a busy engineer about the importance of being innovative?

You can't MAKE a person innovate. You have to LET them innovate. Innovations is not the result of compulsion! Quite the opposite. It's also innate personality types. Some people are prone to follow process, have a methodical organizing mind; others a cluttered mind, filled with disorganized thoughts, much like a disorganized desk, with coffee stained, stacks of paper strewn about, books, journals, tools, pencils, scissors, sticks...

But the key to innovation is having the Freedom to innovate. Another important component to innovate is for the engineer to be able to withstand being clobbered by failures, and be afforded the opportunity to take risks, to screw up. The risk is the investment of time and resources going down a dead end. No way around it. If an organization can't deal with the wasted expense, repairing some damage caused by a faulty idea, and lost time, that's tough.

Another factor that aids the innovative process is a surrounding environment, the ecosystem around you. Silicon Valley has grown to have such an environment, but this environment can be nurtured in other places too.



It does require the seeding presence of enough innovators and entrepreneurial thinkers, experimenters, and doers. It requires banning the use of phrases 'that's not the way we do it here' or 'it's been tried before'. Also 'stupid ideas' must be permitted to be tried.

As I mention in a later section accepting failure and major screw ups, as a normal part of the innovation process is essential too.

I also find that innovation can be made to happen when your back is to the wall, the clock is ticking, deadlines approaching. But it does require a moment to take a breath and ponder the problem at hand. The old adage 'by hook or by crook' is an approach to innovation too. It requires one to have surrendered, the walls of resistance are down, and you become open to listen to a wider choice of what may be possible. At that point one is ready to accept ideas from far afield. And that's where the good stuff lies - way out there.

However, it is hard for large organizations that are established incumbents in a field, to deal with internal innovation led breakthroughs, simply because such innovations disrupt your own currently humming business. This would feel like shooting one's own foot. For startups and organizations breaking into a new field, innovative disruption is their only way in.

Can you share some advice on how you make time to innovate?

For me any and all time is time to innovate. Over the years, I've trained myself to be in a state to accept new ideas any time. But as a routine, there are two specific times. One is my daily run. During the run, I generally present the problem that needs a solution. Then I start running, and let the mind wander about freely. This somehow gets the mind in a really relaxed and easy state, when it seems to connect things together. Surprising answers await me at various parts of the run. I never listen to any music. I simply let my mind wander and listen to my thoughts.

Another time that my mind is actively churning out solutions is early in the morning, just before being fully awake. Often solutions are waiting in the morning for me to record. I've experienced this sort of idea generation frequently and regularly enough that when I'm now faced with a design hurdle that feels like an impasse, I feel a general assurance that it too will get solved. The mind seems to keep working on a solution in the background without prompting.



When it comes to brainstorming or being inventive, what techniques work for you? (Example: taking a walk, tinkering with engine parts, etc.)

For me, being inventive is much more than techniques. It's about a mindset! A certain attitude to be able to examine everything, with a fresh eye, like that of a young child looking at everything around with wonderment, and curiosity. But if there is any technique at all, it's observing. I like to observe the mundane motions of various objects, natural or man-made, to understand how a certain behavior or motion was achieved, whether by nature, or the designer of the product.

In the previous section I described how running each morning has yielded numerous solutions. But I look for new ideas everywhere, even when sitting in my car at a traffic light.

Ideas are indeed everywhere, hidden in plain sight, all around us, simply waiting for us to scoop them up, adopt them, take them home, nurture them and see them blossom.

I mentioned the struggle to fight the 5 C's - the tendency for most living things I know to form stable patterns of existence. As we learn and grow, we form routines. I believe these routines while making our lives more efficient and predictable, are a massive hindrance to the creative process. I constantly try to find all sorts of ways to depart from these routines, to get off the main highway and take the dirt roads.

I like to ask myself 'what if' questions to trigger new ideas. Once again, finding ways to depart from our daily realities is paramount.

Looking backwards and looking forwards. Traveling back in time to various times and places is a great way for me to have a broader perspective, a wider angle lens, to see how human thinking evolves to accept certain ideas and notions, but over time the new notions become completely routine.

And looking from side to side. By this I mean looking for solutions in other fields, close by and far away. The more remote the field the better. It's quite interesting for me to observe people in various fields, completely unaware of the expertise and solutions that other fields utilize for similar problems. When I worked for SDRC, now Siemens PLM, 20 years ago, as a CAD-CAE-CAM

application engineer, I would travel regularly to customer sites all over the world, trying to assist engineering personnel develop new products, or address design challenges.



Over time, I realized how Detroit thinking differed from that in Seoul, or Helsinki. While these are geographical, I noticed similar variations of thinking and problem solving in space, aviation, automobile, and electronics industries. Being aware of unique solutions to similar problems in various fields opens up a far bigger solution set to search for answers. This is where seeking answers from people who are not in the field, presents a sizable advantage.

When I'm faced with a certain design problem, while I'm not conscious of it, my antennae is out, like being on a hunt, on a lookout for new ideas of all kinds, wherever I go, wherever I look, all the time. That's my mindset. Often, these ostensibly stray observations find ways to connect to each other, and to past observations from a long time ago, presenting a workable, sometimes elegant, solution.

Who are some of your favorite innovators?

Wilbur Wright, Burt Rutan, Henry Ford, Charles Lindberg. These are my heroes.

Wilbur Wright for having the most acute ability to observe nature, and draw out the essence of control in a birds' movements.

Henry Ford for imagining a world that most could not see, and building a car when roads did not exist.

Burt Rutan for the purest of designs based on function alone, a unique ability to abandon prevailing norms and protocol of aircraft design, to build the most efficient and radical of aircraft.

Charles Lindberg for defying all conventional wisdom regarding redundancy, safety and prevailing thinking on risk management, and placing singular confidence in the capacity of an individual. In making the historic first nonstop Transatlantic 35-hour flight in an airplane with a single engine, single pilot, no floats, no backups, for anything!

What are some of your favorite innovations?

I have the highest respect and regard for human resourcefulness and ingenuity, wherever I see it. Consequently, I love every innovation, whether an incremental improvement that makes life

@FordInnovation



PD Innovation

IdeaPlace

easier or a whole new sophisticated system. But I particularly like products that deploy remarkable simplicity to produce sizable outcomes. Big Ideas in a small footprint - this is an important feature of innovation for me. I admire the series of products resulting from the centuries old chain emanating from a farmer's resourceful implements leading up to today's automated farming equipment.

I admire and respect every innovation, every product that breaks a prior mold, that departs from the present and establishes a new normal; challenging conventional wisdom, especially challenging market research and thumbing its nose at the expert naysayer, in favor of the inventor's own vision.

The outgrowth of the aviation industry is hard to have imagined in 1900. The humble beginnings of barely flying crafts made from sticks and fabric, have led to today's massive jetliners that each carry hundreds of passengers, and have led to a transportation revolution, with massive networks of metropolitan airports - cities of their own, with complex infrastructure, complete with restaurants, coffee shops, shopping malls, freighting goods and people all over the world.

Demanding dramatically unreasonable performance from each of a large collection of components takes an outrageous audacity of thought, optimism and trust in human competence to deliver. The smart phone certainly fits that category, packing massive computing capability, huge energy and data storage, touchscreens, outrageous secondary capabilities with cameras, sensors, gyros, transmitters, receivers, and more, into the tiniest sizes.

Velcro is a uniquely simple but versatile invention, and a wonderful example of a product built directly upon the acute observation of nature. Every time I open a Ziploc bag, I consider the extraordinary widespread impact of such a simple elegant product on people everywhere.

Oh, and accidental products like fiberglass and microwaves! I love them too!

And a bird building a nest can scarcely be ignored!

@FordInnovation



PD Innovation

IdeaPlace

Can you share a favorite, inspiring quote?

I am inspired by so many extraordinary people, as they come from different vantage points:

Henry Ford on inner drive - “Whether you think you can or think you can't, you're right!”

Thomas Edison on giving up - “Our greatest weakness lies in giving up. The most certain way to succeed is to try just one more time.”

Winston Churchill on giving up - “Success is going from failure to failure without losing enthusiasm.”

My own on expecting failure - “Failures are essential; they are the fuel stops on the road to success.”

Herbert Hoover on the nobility of the engineering profession -

“The great liability of the engineer compared to men of other professions is that his works are out in the open where all can see them. His acts, step by step, are in hard substance. He cannot bury his mistakes in the grave like the doctors. He cannot argue them into thin air or blame the judge like the lawyers. He cannot, like the architects, cover his failures with trees and vines. He cannot, like the politicians, screen his shortcomings by blaming his opponents and hope the people will forget. The engineer simply cannot deny he did it. If his works do not work, he is damned...”