

When to Stop Innovating: Ten Lessons from the Edge

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Good afternoon. I thank Ron Trewyn and the Kansas State University Research Foundation for the opportunity to be with you today. One year ago, Tom Thornton of the Kansas Bioscience Authority spoke to this group about the KBA's efforts to bring new business to Kansas. Today, here I am. That was fast work.

Innovation, or change from the old and creaky to the new and improved, receives universal support in the abstract. Thus the management consultant Tom Peters can say *"To meet the demands of the fast changing competitive scene, we must simply learn to love change as much as we have hated it in the past."* Or as Mae West puts it, *"Too much of a good thing is wonderful."*

On the other hand, innovation is often vehemently opposed in the concrete. Coco Chanel once said, *"Innovation! One cannot be forever innovating. I want to create classics."* Coco might have pointed to the hurried product progression in the 1980s from Coca-Cola, to New Coke, to Coke Classic, as a cautionary tale that classics have value and that mere novelty is not always enough for success. According to this viewpoint too much innovation is as bad as too little and there is an amount that is just right. We might call this the "Goldilocks" model of innovation.

The purpose of my talk today is to discuss who is more correct about innovation, Mae West or Goldilocks. Is more always better, or is enough enough?

I will speak from my perspective as an investor in a half-dozen small companies, and as a co-founder of two. In its early years my first company, Orbital Sciences, blew up a lot of rockets. My second company, Edenspace, took altogether too long to reach the obvious conclusion that Kansas is the perfect home for a crop biotech firm. So, I've made plenty of mistakes from which others can learn. From this experience I distill ten observations that I would like to share with you today.

Observation #1. Raising money is hard. Our investment banker, John McKenna of Hamilton Clark, has joined us today. As he can attest, fundraising is usually a tough challenge, and if it takes too much time then innovation slows or stops. It is important, therefore, to spend money carefully. In Orbital's

early days, when our American Express cards were our major source of financing, the other two founders and I would triple up in hotel rooms – two beds and a cot. We had a rotation system for the cot: Dave Thompson had the first ten days of the month, I had the second ten days, and Scott Webster the last eight to eleven days. So, saving money also can be hard, but it's usually easier than raising money.

The first point thus goes to Goldilocks. It is easy to have too much innovation and not enough cash.

Number 2. It's the customer, stupid. Winston Churchill concluded that *"We must beware of needless innovations, especially when guided by logic."* Sometimes our inventions run away with us to a place that customers have no desire to visit, much less live. Consider the case of personal computers. In 1983 my Apple IIC booted up in about five seconds, while in 2008 my laptop takes up to five minutes – more than an order of magnitude slower. Battling pop-ups, recalcitrant help screens, and perversely illogical user interfaces is now a way of life for users of telephones, computers, televisions and many of our other most cherished machines. If we create a logarithmic scale of unnecessary complexity on which the Internal Revenue Code ranks as 1.0, the "IRC Scale," then I'd estimate most electronic user interfaces at about a level of two to three on the scale, that is, a factor of ten to one hundred times more irritating and time-wasting than the Internal Revenue Code. In this case rapid incremental innovation has culminated in vulnerable industries, ripe for disruptive change. If we are quiet, we can almost feel the building anger of the downtrodden masses, awaiting their day of liberation from such dark hallmarks of technoservitude as the need to use three remotes to watch a DVD movie.

Goldilocks also wins this point. To understand and use most innovations takes time. Customers have only finite amounts of time. Therefore, customers can tolerate only finite amounts of innovation.

Number 3. Innovation is more than technology. In April 1860, 17 years before Edison received a patent for the phonograph, French inventor Édouard-Léon Scott de Martinville used a machine to make graphical recordings of a woman singing "Au Clair de la Lune." However, the Frenchman was dismissive about the value of making a machine that actually *played back* the sounds he recorded, leaving it to Edison to figure out that people enjoy listening to music more than they like to look at squiggles on a page. The most useful innovation is not only something that people need to use, it's something that people want to use. It's about doing things better, whether a new widget or a new licensing agreement for widgets. It's about better laws, not necessarily more laws. It's about lowering the average IRC Scale of our lives, as much as increasing local employment or consumer choice.

This point goes to Mae West. While there's too much half-baked innovation in the world, there is not nearly enough of the amazing, fully-developed innovation which sparks that surge of wonder and gratitude toward inventors who so clearly understand *us*.

Number 4. Try to make sure the same group of people participates in both the risks and the benefits of an innovation. Using windmills to generate electricity benefits consumers. To some extent it may also benefit the world at large by reducing the emission of greenhouse gases. However, large windmills may reduce the property value of the surrounding land. To implement this innovation, it may be helpful to compensate these landowners with cash payments, higher rents, or availability of subsidized power. Similarly, crops that are bioengineered with traits such as insecticides or herbicide resistance benefit farmers by reducing their costs of growing the crop, and may benefit the world at large by reducing the use of pesticides and herbicides. For some people, however, the small decrease in food cost is dwarfed by the worry that crops containing, say, an insecticide, are unsafe to eat. Under this line of reasoning it would be desirable for bioengineered crops to confer benefits directly to consumers – benefits such as higher nutrition, lower fuel costs, and reduced incidence of diseases such as colon cancer and ischemic heart disease.

This point is a tie. The lack of congruity in risk/benefit populations can be seen as either too much innovation for the group that benefits, or not enough innovation for the group at risk.

Number 5. Weigh the costs and benefits to the customer. Imagine that you're the program manager of a launch vehicle, costing 200 million dollars, that in eighteen months is scheduled to orbit a national security satellite costing another 300 million dollars. Your lead guidance and navigation engineer comes to you in great excitement with a proposal. Let's swap out the existing ring laser gyroscope system, he suggests, with a new nanotech solid state system. It's lighter, allowing us to carry about five pounds of additional payload, and it's much simpler, so should have a lower risk of failure. Not only that, it costs about \$150,000 less than the current system, even allowing for the necessary redesign and ground testing. The drawback is that the system has limited operational experience and has never flown before in space. What do you decide?

If you are an experienced program manager the answer is crystal clear: you stay with your current system. The benefits to your customer – and to you – of saving 150,000 dollars are far outweighed by the risk of losing a half-billion dollar mission. Of course, space is a special case – it's hard to fix

things when the nearest repairman is on another planet. A general version of this rule is that you should constrain innovation when it comes to big, one-time events that can't be fully tested before customer use. The more innovative things you try to do in creating a new product or service, the more things are likely to go wrong.

Advantage: Goldilocks. If the probability-weighted customer benefit of an innovation is outweighed by the probability-weighted cost to the customer, then you have too much innovation.

Number 6. Stick to your guns. You can only succeed if you first survive. Those things you've heard about the importance of commitment and persistence? They're all true. Early on during some rocky times at Orbital Sciences we agreed to keep working for six months *after* the company was declared legally dead, just to make sure we'd given it everything we had and left no stone unturned. With apologies to Kris Kristofferson, sometimes innovation is just another word for having nothing left to lose.

I wouldn't be speaking to you today if it weren't for the determination of many people to bring Edenspace to Kansas, including the Governor, the Secretary of Agriculture, key members of the State Senate, the Kansas Bioscience Authority, Kansas Technology Enterprise Corporation, Kansas State University, the City of Manhattan and its Chamber of Commerce, and Ventria Corporation. It's an impressive number of entities, and the coordination among them was also impressive. Most of all, I'd point to the efforts of the City Manager of Junction City, Rod Barnes, who together with Josh McKim and the City Commission fought through various issues that concerned Edenspace about a Flint Hills location, such as lack of a major airport. This group showed the type of commitment and vision that characterizes the very best people I know.

They continue a proud tradition. As the frontier moved west in the late 1860s and it appeared Fort Riley would close, Junction City borrowed and invested heavily in reinventing the city as a railroad nexus. It succeeded and found, ironically, that the city's new prominence as a transportation center persuaded the Army ten years later to maintain and expand Fort Riley as a supplier of hay, and later of troops, to bases throughout the west. Determination and innovation can bring unanticipated benefits.

I'd give this one to Mae West. Life is a lot richer and more interesting than a card game because it's not fixed-sum and it has many, many degrees of freedom. So, don't fold your hand too soon. Even the most intractable problems

sometimes yield to the combination of innovation and determination, of which too much is wonderful.

Number 7. Continuous improvement is innovation. Many of you are familiar with the precepts of total quality management, including the focus on continuous improvement. Because of constant change in customer needs, supplier capabilities, technology and the rest of the business environment, there are always ways to increase value to the customer, increase safety, reduce errors, and lower costs. Increased attention brings increased benefits.

So, this point goes to Mae West.

Number 8. Dear Bruce: I just had my third heart attack. Should I stop innovating? Answer: No way! It's definitely time you tried something new. Generally when you have good cards you stand pat, and when you're dodging bullets you try to be someplace else. So, a heart attack is nature's way of telling you to innovate like crazy. Change your diet, get more sleep, stop smoking and drinking, exercise. Maybe also file a patent application.

Point: Mae West. We can never be too rich, too thin, or live too long.

Number 9. If you test it, they will come. Corollary: anything you haven't tested will break when you demonstrate it to a potential customer or investor.

This is a tie between Goldilocks and Mae: More testing is always better, but eventually you need to ship the product.

Final observation. Something there is that doesn't like a change. We are all familiar with what I call Future Jawdroppers – ideas that are so obviously sensible that fifty years from now our descendants will look back at our *rejection* of them and wonder about our sanity. Consider Golden Rice, bioengineered to provide beta carotene, or provitamin A, to help compensate for low levels of dietary Vitamin A that every year cause more than a quarter-million poor children to go blind. Almost a decade after its development in 1999, despite every indication that the rice is both safe and effective, it still has not yet been approved for use, the victim of overseas opposition to bioengineered crops. And, in this time when the price of oil has soared above one hundred dollars per barrel, and when concerns are mounting about the environmental and safety costs of producing power from coal, consider the extent to which opposition in the United States to expanded use of safe and clean nuclear power contributes to global warming and a lower standard of living. And, when every scientist or engineer who immigrates to the U.S. generates up to five

new jobs in this country, consider that each year the U.S. grants work visas to only a handful of these incredibly smart, talented, honest, and hardworking people. Fifty years from now with all the jawdropping everyone may have TMJ.

These examples highlight a serious problem: Consumer need and desire for an innovation aren't enough to ensure its use. Deep in our human nature are fears that slow the introduction of useful changes – fear for our safety, fear for the "purity" of our food and environment, fear of strangers, fear of loss, fear of change itself. These fears manifest themselves in laws and regulations that in many cases accurately reflect public sentiment, and hence are legitimate in our political system, but which nonetheless often have adverse consequences that are exactly opposite to those desired. Characterized as "Future Shock" by Alvin Toffler almost forty years ago, this resistance to change may actually increase with the velocity of change. Alexis de Tocqueville wrote: *"I cannot help fearing that men may reach a point where they look on every new theory as a danger, every innovation as a toilsome trouble, every social advance as a first step toward revolution, and that they may absolutely refuse to move at all."*

The general problem is that we have imposed on ourselves a plethora of regulations and laws, intended to protect us or achieve other valid goals, but whose increased costs and delays often have the side effect of slowing or even halting innovations that could benefit all of us. If we're serious about innovation, we need to start using more complete benefit:risk analyses that give as much weight to spinoff benefits as to spinoff risks.

Point to Mae West. There's a rip tide of forces that drags back the pace of innovation. Look at living conditions of most of the six billion people on this planet and you may conclude, as I do, that we urgently need to find innovative ways of making informed public policy choices.

Tallying the score after ten hard-fought rounds, with a half-point awarded to each lady for ties, it's Mae West 6, Goldilocks 4. The result proves conclusively that more innovation is usually wonderful, and looking around me, it's clear that Edenspace has come to the right place to innovate.

Thank you.