Business is Physics

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As the world moves towards commercial applications of quantum information, quantum computing and practical applications of nano-technology, 21st century business will be lead by physicists in the lab and in industry. Sadly physicists are endangered specie and my talk will focus on why it is important Physicists are placed on the endangered species list, and what can be done to ensure their survival and usefulness to our society. My perspective is that of a lawyer/entrepreneur and venture capitalist who has had the pleasure and challenge of financing start-up companies in high tech and resource industries for about 25 years.

I appreciate the opportunity of sharing a few thoughts with you to-day on the role of physicists and physics in the business world over the next generation. I think my experience yesterday going through US Immigration officials demonstrated that this link is not well appreciated. I was asked, rather rudely, (not withstanding the printed material beside the immigration officer's booth that we will be treated with respect) What was I going to do in Monterey. I said, "Give a speech to a group of physicists." "What are they paying you?" "Nothing!" I said. "What are you talking about to a bunch of physicists?" "The role of physics in business." "physics and business- You must be kidding! " he said and looked at me as if I should be denied entry for being of unsound mind.

Similarly, while looking at various stuff on the internet on the education of physics, I came across a comment by the Jobs editor at Nature Magazine

He said "Perception is that physics education offers a viable career path to career in research. He goes on to say "SADLY some of that optimism is likely to be tempered in time, when aspirations meet reality. Half the graduates will be aiming for positions at research universities but there simply aren't that many positions available. As a result, some of this year's class may well find themselves working as stock-market analysts, information-technology professionals-or even side by side with biologists… "as if this were akin to having aids or the bubonic plague. God help those physicists if they ever rubbed up against lawyer or even, heaven forbid became one of them.

This attitude within the physics community is not constructive. What he should have said is that training in physics is a door opener for anything you want to do. Based on my experience of funding start-up companies in many different fields, training in physics prepares one well for business.

Physics grads can go to med school, business school, law school and into economics and biological areas with relative ease. Business is all about analyzing complex issues and developing and implementing a strategic plan for commercial gain. As all strategic plans get altered over time by changing circumstances, to be successful a business has to be capable of dealing with the unexpected. Physicists are trained to do this. Physicists love problems because problems need solutions. Physicists are not discouraged by setbacks.

In a simplistic way I think in some ways physics is easier than business because one is dealing with problems that nature has answers to. The trick is to find them. Business has no such underlying fundamental reality other than it must make a profit to survive. Creating business models such as Google did is not finding the solution to some unanswered problem in nature. As one whose job it is to fund creative people that can build a business, backing people with a solid background in physics improves one's chances for investment success.

I was very excited to hear IBM'sDr. Tom Theis talk last night because he made the same point I would like to make. In computing we are back to dealing with fundamental laws of physics to over come the computing and economic barriers raised by heat dissipation problems. The same is true in the area of biology and judging from a conversation I

had at breakfast with Mark Kryder the same is true in the disk storage field. The problems are economic as well as physical and there will be a corresponding need for physicists in business side of innovation as well as the labs. It is the entrepreneurs backed with angel and venture capital money that will create the economic business solutions to the problems outlined by Tom and Mark.

My first objective here is first to demonstrate to you that business has been driven by physics for quite along time.

Secondly I hope that some of you will be interested enough in the relationship between business and physics that you will

i) aggressively pursue industry for financial support for your research visions, will

ii) beg and plead venture capital and angel investors to finance your ideas that have commercial potential,

iii) will work to convince governments that increased funding for physics will ensure economic prosperity through innovation and cure cancer along with a host of other diseases.

Thirdly I hope you will inspire and encourage many of your students to pursue non-academic careers where their skills and talent can change the face of business. Encouragement comes by making them aware of the endless opportunities for challenging, interesting and financially rewarding careers in high tech, finance, law, medicine, biology,and engineering. A few examples from my own small world.

Examples- My son Jason is an undergraduate physics major from UBC and later a MBA from MIT Sloan school. He is now a CEO of an internet bank at age 38

Mohammad Kermani age 38 UBC PhD Particle Physics is now CEO of Bycast Systems a grid computing company providing software to customers through IBM and Hewlett Packard for storage of medical images on hospital servers around the world

Dan Friedmann UBC engineering physics, CEO of MacDonald Detweiller a billion dollar company in Vancouver that pioneered satellite groundstations and now provides services to governments all over the world in mapping and land management etc

Dr. Geordie Rose UBC PhD in theoretical physics who was a founder and is CTO of D-Wave Systems in Burnaby BC developing a quantum computer.

Barclay Isherwood, UBC masters degree in Astrophysics, now retired- who built a company that pioneered the development of data over radio for Federal Express and which was bought by Motorola.

Dan Gelbart, physics and engineering background, cofounder and CTO of Creo Products in Vancouver -developed computer based printing technology. Creo was bought last year by Kodak for $1.2 billion dollars.

Martin Ertl under graduate physics at UBC and UBC Law, a co-founder of Navarik, a small but rapidly growing company, that provides shipping management software to Shell BP and other large oil companies around the world.

Dr. Lorne Whitehead, UBC optical PhD in physics in optics whose research is sponsored at UBC by 3M and who while carrying on his research, has initiated three start-

upcompanies from his UBC lab that produce products used around the world.

I would like to start my talk with a little good news and bad news. The good news. According to the American Institute of Physics, since 1998 the number of US citizens enrolling in graduate physics has gone up by 47 percent and US nationals made up 55% of first year graduate physics-. Interestingly 1/3 enrolling are Chinese but unlike in a few years ago many of those talented people are returning home.

For your area in particular, the world of quantum information is going to explode on the world and allow problem solving, and material and drug designs to flourish in ways that will seem magical at first. If I were smart

enough to be a physicist and young enough to give it a try(neither possibility seems realistic at this point) I would pick quantum information and/or quantum computing as starting place to launch an entrepreneurial business career.

The bad news is that government funding in the US, at least, is hard to come by in physics and due to the increasing demand for money to finance foreign adventures and rising health care costs, government research money for areas you are interested in will continue to be a struggle. How much of your day is already taken up writing or administering government grant applications?

MY BACKGROUND

It might be worth while at this juncture to give enough of my background and experience so you can understand why I am an advocate for the increase in funding for physics

research and education AND particularly in the area of quantum information.

I grew up in a well known Canadian legal family. As a youngster dinner table stories revolved around the lawsuits my father and grandfather were conducting or judging. The parade of characters that were mowed down in cross-examination by my forebears included engineers, doctors and scientists who were expert witnesses in various trials to do with dying patients, falling bridges and crashing airplanes. The world of physics was on another planet for me.

I took economics, political science and English at UBC and regrettably graduated without taking a science course. In 1963 I graduated from the University of Pennsylvania Law School and returned to Vancouver to follow in the family tradition of suing and defending. I enjoyed it for 5 years.

During a trial involving a bunch of oil and gas promoters and geologists I had to understand some complexities of geology for cross examining a witness. In explaining the complexities to me my client had a way of making the rocks come alive and triggered a long term interest in me in geological processes. One thing lead to another and I left the practice of law and joined with a couple of friends to start what became a large venture capital firm in Vancouver called Ventures West. In the 1970s and 1980s Vancouver was a technological desert so we concentrated our investments in the oil and gas and mining industries. My first encounter with physics was geophysics and I quickly learned that no geophysics no oil and in many cases no mines. The list of geophysicists who started successful mining and oil and gas companies in Canada and the US is a long one. It might surprise you to know that one of the

major technology companies in the world, Texas Instruments, was started by some geophysicists led by Dr. Cecil Green.

Brief history of TI

The impact those geophysicists have had over the last 50 years in for students and scholars at MIT UBC MIT Stanford etc is quite phenomenal. It all started with a physicist who in 1942, decided an airborne magnetometer would be a good submarine detector.

In the 1970s my firm funded a wild inventor who had invented a rear projection screen that worked well in daylight conditions. To understand how it worked and how to improve it we made contact with a Dr. Lewis Walkup, an

engineering physicist who was a chief scientist at Battell Institute in Columbus Ohio. He was a marvelous combination of scientist, inventor and philosopher and was the first scientist to recognize the potential of the Carlson invention of the Xerox Machine. Over lunch he recounted the early history of the commercialization process for the Xerox machine of which he was a major force .

In the mid 1970s we financed the first mineral exploration program in the Canadian north using geological data interpreted by a PhD in Physics from the University of Michigan Dr. Bob Vincent. He had been hired as a PhD in optics to bounce lasers off the moon's surface and try and figure out from the optical response what kind of rocks the astronauts could expect to land on. He then took a PhD in Geology and was a pioneer in the use of satellites for commercial applications.

In the 1990s UBC had the foresight to hire as its president a geophysicist called Dave Strangway. He had been a NASA scientist and headed the geological and geophysical work on the moon. After a stint as a prof at MIT and a VP of U of Toronto he came to UBC and started a process of hiring a lot of smart people a couple of whom of here to day. He understood the process of linking research to commercial and societal needs and opened a program at UBC where science and engineering masters students could take business courses for credit so they could learn something of the business process while studying their science. As a result of his initiatives UBC tore down the ivory tower and its scientists are now creating companies as fast as any where else on the continent. I worked closely with Dave Strangway on a variety of initiatives including developing our Science Centre in Vancouver and encouraging Cecil

Green to finance a graduate college at UBC called "Green College"

The last key link for me was teaching an entrepreneurship course at UBC for 9 years that was open to all science and engineering graduate faculties at UBC as well as MBA students. For 9 years I had 40 students a year, half of whom were science and engineering grad students and the other half were MBA students.

In addition to learning about the business process from myself and leading local experts in law, management, product development, marketing and finance, the students worked in teams to develop a business plan for a technology they had to find themselves. Each year the number of physicists in my class increased and over-all many of them were my "superstars" None of them took the course with an intention to become entrerpreneurs but several of them

took the plunge and I am currently financing 3 of the companies they started.

Because the technology of D-Wave relates to processing of quantum information, I would like to use D-Wave as an example of how people like me will finance "off the wall" ideas of young physicists, if the people are smart, motivated and have picked a problem, the solution to which, would be very disruptive to present industry technology and would create a huge economic win for the financial backers. What do I look for.

- **Super smart people- 1st in class**
- **Commitment and determination**
- **Competitiveness- the two D-Wave physics PhD founders one was an Olympic wrestler and the other a brown belt.**

- **Disruptive technology-Solution to the end of the classical part of Moores law as described by Dr. Tom Theis**
- **All the experts say it can"t be done or will take 20 years so big companies and large vcs are not pouring vast sums and talent into the area.**
- **Financial leverage through government grants or collaborative agreements with research institutions**
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D-Wave started in 2000 in a basement. It now employs 35 people; has had $30,000,000 of equity funding and an equal amount of government funding from a variety of governments-French, German, Swedish, Canadian and British has been accessed. It has filed over 130 patents. Whether the company will commercially succeed is still unknown but our young scientists have had access to leading

scientists around the world, the opportunity to publish papers and use state of the art equipment that would be unavailable to them in many academic environments. They have also learned the discipline of meeting timelines, benchmarks and budgets. Of note is the fact that as D-Wave's need for the theoretical side is reduced and its shifts into an engineering and production mode, the scientists we have let go have had no problem finding positions in academic institutions.

As the D-Wave hardware is designed for specific software applications there is interaction between the scientists, engineers and patent folks to ensure that what is developed for a customer's needs works. Every technical person is schooled in IP and patent matters so the scientists and engineers understand the value and methods for developing and protecting IP. Of course all employees are shareholders

so if D-Wave is a financial success you can expect physics departments around the world to benefit from the largess of D-Wave employees.

SUGGESTIONS FOR INCREASING THE NUMBER OF PHYSICISTS and THOSE PHYSICISTS WHO CHOOSE A CAREER IN BUSINESS

1)get involved politically- elected office –advisors to politicians and government departments- For example, the talk that Dr. Tom Theis gave last night should be repeated over and over by him and others to opinion-makers in government, business and the media. Don't you wish that the US president had an academic background like the current German Chancellor who is a quantum chemist. It is not a surprise that research funding in Germany is headed for a big increase. Two days ago I heard a senior Chinese bureaucrat state in Vancouver (a bureaucrat with a $10

billion research and innovation budget) that China will increase research and innovation funding from 1.2% of GDP to 2.5% of GDP by 2020 notwithstanding China's GDP is compounding at greater than 10 percent annually. That's big bucks.

Our challenge in North America to have significant funding directed to physics education and research is compromised by foreign wars and the increasing burden of health care as the huge number of us fat old goats get older and sicker and want to be looked after at state expense until we breath our last agonizing gasp AND because we have the votes.

If you want government funding for your research you will have to convince voters and the media, including Neanderthals like Lou Dobbs of CNN, that physics driven

innovations create jobs, cure disease and generate lots of tax revenue.

2)organize problem solving brainstorming sessions within your physics departments for grad and undergrads with entrepreneurs, cios ceos and senior government bureaucrats that are interested or responsible for innovation.

3)Encourage your students to take entrepreneurship courses in the business schools of your universities.

4)Invite rich physics grads for lunches and tours of labs and most importantly to listen to presentations of new research by top students who have good communication skills.

I will end by where I began. Business is physics but all of you must spend some of your time educating those that need to

know and you need to learn about the business process of bringing research ideas to commercial fruition.

Thank you for your attention