

Growing up with the Faculty of Information Technology

Rensselaer Polytechnic Institute Gamma Nu Eta Information Technology Honorary Society

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Thank you for letting me share this wonderful evening with all of you. Congratulations on all that you have accomplished and “thank you in advance” for all that I know that you will do to change our world for the better. We are all proud of you.

For me this is a fulfillment of a dream. It was a dream that we had over 20 years ago, and it was a dream that took a lot of work by a lot of people in order to become a reality.

Many of you, and the RPI Faculty of Information Technology, have grown up together over the last two decades. And what a score of years it has been!

Just as Newton’s Laws drove the Industrial Revolution, Maxwell’s Laws drove the electrical revolution, and Einstein’s Annus Mirabilis of 1905 drove the electronics revolution, there were three key laws that drove the information technology revolution.

Those laws are:

- I. **Moore’s Law** for doubling computing power
- II. **Gilder’s Law** for doubling communication bandwidth
- III. **Metcalf’s Law** for network economics.

Moore’s law gave us constantly increasingly powerful computing systems that also got smaller and smaller. The underlying driver was the number of transistors that could be incorporated on a small chip. While Moore’s Law seems to be leveling off by the standard definitions, there are those who think that by broader definitions it has not leveled off at all.

Gilder’s Law meant that networking became ubiquitous, inexpensive, and with ever increasing bandwidth. As a student of the progress of technologies and the way they enter societies, I was struck by the parallels of the railroads and the internet. Railroads terribly overbuilt their infrastructure with freely available investment capital. Then most of those railroads went bankrupt and were acquired by others at pennies on the dollar. The original investors lost most of their investment, but the result was an extensive railroad infrastructure with a very low cost. Entrepreneurs like Commodore Vanderbilt benefited mightily from that low cost infrastructure. Similarly, fiber networks were built out at a staggering rate and Bell Labs and others kept finding ways to put more and more bandwidth on the same fibers. Again, investors took a bath as bankruptcies ensued, but the result was an infrastructure of low cost bandwidth that is at least partly responsible for the business environment of today.

Metcalf’s law showed that the power of a network scaled as the square of the number of nodes in the network. Thus, any network that established a size advantage over another would establish a positive feedback system that would cause that network to grow. If a network was twice the size it was worth

four times as much. If the network was ten times the size it was worth 100 times as much. Social media was the beneficiary of this power as Facebook dominated MySpace, Google buried Yahoo, Alta-Vista, and fended off Bing, Amazon is dominating retail, and many other social media startups are flourishing –from Tinder to Twitter to Snapchat.

These three laws are shaping our economy, our social structures, and our laws. Consider how Uber and Lyft are disrupting taxis or how Airbnb is challenging both the hotel industry and the cities and towns that tax and regulate the hotels.

I published my first article in 1984 detailing the “Three C’s” of **Computing, Communications, and Cognition**. You can see that these relate quite closely to the three laws. Moore’s Law was driving better computers while Gilders and Metcalfe’s Laws were driving our communication networks and even the social aspects of our communication.

The Cognitive Sciences brought an entirely new and powerful force to the environment. By observing both human beings and evolving computer algorithms, we were learning how people and computers could learn. We saw similarities and differences. We quickly learned that computer algorithms could out pace human judgement in such things as picking basketball stars, military officers, fine wines, radiological images, and stocks. Much of this work built upon the Nobel Prize winning work of Danny Kahnemann and Amos Tversky who identified two human systems of judgement which they called the fast and slow. To this very day, the experts in each field vehemently deny the truth of the research, but the evidence is overwhelming. My favorite denials include those of basketball star Charles Barkley who did a public rant against analytics -in spite of the fact that the data was overwhelming. Stock pickers are equally vehement about their abilities, and radiologists are trying to do all they can to obscure the fact that algorithms outperform them.

As the 1990’s progressed it became more and more apparent that Information Technology was much more than just computer science. Employers were coming to us and saying that they thought our computer science graduates were terrific, but that it took such a long time for the new graduates to be able to put the technology in the context of the changing business models. Instead of students who were incredibly bright in computing, they were looking for graduates who were incredibly bright in computing AND in business, chemical engineering, medical devices, financial services, civil engineering, and many other fields.

We simply needed a new kind of field –one which would break down the traditional silos.

And thus was born the Faculty of Information Technology at RPI. Like any new idea, some of us loved it immediately, others were quite suspicious, and still others were outright hostile to the idea. To some, it was kind of an academic heresy. If you were a Chemical Engineer, then you might feel that wasting credit hours on IT would dilute your education and make you less of an engineer. If you were a computer scientist, you might feel that the new program would not give the students enough depth in computer science to be useful. One faculty member, who was a great friend and one of the top research faculty members on campus, came to me to tell me in a friendly way that he liked me and

wished me well but that he would have nothing to do with the Faculty of Information Technology because it was a bastardized program.

Fortunately, by that time I knew enough about the research on innovation to realize that I did not have to convince everyone. I had to find a few champions who were also opinion leaders. I would waste no time trying to convince or argue with the hostile. I did not feel that I had to spend too much resource on convincing the suspicious. There were ways to reach them, but argumentation was only a small part of that. The path to success went through the champions and then success would breed success. Let's start with the champions and create the program.

Which was exactly what we did.

Happily, RPI is an innovative place. (I note in passing that three out of my four children graduated from RPI. The fourth escaped to study English and creative writing.) We had plenty of people to work with, and the suspicious and hostile groups were too busy and uninterested to care much. We put together a terrific program with the champions.

Then we did something that turned out to work very well. We announced that all faculty in the F.I.T. would be dual appointments –at least to start. Faculty members who wanted to hold the dual appointments would have to apply to be selected. We were overrun with applicants –and they were many of our top faculty.

My satisfaction was complete when my friend and formerly hostile faculty member, Mark S, came to my office and said that he apologized for not meeting the deadline, but would I consider his application –even though late. I graciously agreed to do so. Are you KIDDING ME? I was thrilled. By the time the faculty was formed, there were very few holdouts. In academe you cannot ever win over everyone, but we had more than a critical mass.

Like the perfect storm (but in a good way) two threads intersected in my life. We had an outstanding Trustee who was an executive at AT&T and had always been one of the most creative and supportive Trustee's at RPI. His name was Greg Hughes. One day he called me to say that he was planning to leave AT&T to "follow his passion." "Greg, that is great!" I replied. "What is your passion?" "I want to teach at RPI and work with the outstanding students." He replied. This was another "ARE YOU KIDDING ME?" moment. As an active Trustee Greg was well aware of the new initiative and had helped provide advice on the creation. But then I realized that "Greg, I can never begin to pay you what you are worth." "Don't worry about that Jack. Pay me whatever you think is right and that will be fine."

And so Greg Hughes came to RPI to follow his passion.

I asked him to serve as the first head of the Faculty of Information Technology. Then, as now, some faculty are not supportive of individuals coming from industry into academe. I myself am quite enthusiastic about that. One of the naysayers was on the faculty senate. I took Greg to the faculty senate to introduce him to the rest of the faculty. After the introduction and a few comments, the

naysaying faculty member drew himself up in full pomposity and said “Well Mr. Hughes, you may find things very different here at RPI.” “Oh, I am a graduate of RPI and have been serving on the Trustees, so I have had some chance to know the culture,” replied Greg. “Mr. Hughes, we specialize in engineering and science and not business, the naysayer continued. “I am a Chemical Engineer” Greg offered. “Oh yes, Mr. Hughes, but most of us have PhD’s here in technical fields like engineering,” the naysayer continued. “Oh yes, I also have a PHD in a technical field –from Princeton” Greg replied as innocently as a choir boy. We all watched the naysayer deflate before our very eyes. The steam had gone out of the opposition.

And thus the new Faculty of Information Technology met the newest RPI faculty member in a perfect storm of magnificent proportions. And the rest is history. And here we are today at meeting of Gamma Nu Eta (Gregory N Hughes?) honoring some of the results of that fortuitous intersection. Your chapter was the founding chapter and your program is identified as the number 1 IT BS program in College Choice Rankings. And you are the top students in this program.

At the time of the founding of the faculty of IT every business in the world was being transformed by IT. The challenge was to find people who understood the incredible power of *Computing, Communication and Cognition* and could help enterprises transform themselves.

While that continues to be a challenge today, we are well down the road. We are now entering an era when our cars will drive us instead of us driving our cars. Where our TVs are listening to (and even watching) us, rather than us listening to the TV. Our computers, phones, and other devices are routinely turned against us by individuals, industry, and government. Is Amazon Echo or Google Home or Apple Siri actually our servant, or is it our monitor/spy keeping track of our every move and feeding that information to those who want to control us, sell us something, or even do us harm? I grimace when I hear that people are worrying about the government (NSA, CIA, etc.) snooping on us, but I shake my head in dismay when I realize that these same people seem to have no clue that Google, Amazon, Facebook, and other social media are routinely scooping up everything that we post and then selling that data to the highest bidder. When there was a huge uproar about the NSA’s collection of meta-data in 2015, that collection was stopped. Democratic pressure actually worked! Somehow people still believe that the NSA was scooping up much more illegally –but it was just the meta-data. In any case, I cannot fathom why folks can get themselves into high dudgeon about the NSA and NOT seem to care that all of these enterprises are doing far more -and you have almost no control of who your data is being shared with.

I found it ironic that just this month Congress passed a bill granting the telecom providers the right to do exactly what the social media providers have been doing all along – taking all your personal information (without a warrant) and sharing it with whomever they want at whatever price they can get –and there was public outrage. I agree! But! And it is a big BUT! Where is that outrage at the other social media providers doing the same thing?

It is also overwhelmingly clear that nation states are collaborating with shady non-governmental entities to successfully manipulate public opinion and influence elections. The Russian influence in our most recent election is beyond debate by anyone except the most partisan politicians. We have been

watching a similar effort in France as Russian interests boost Marine LaPen and try to damage her opponents. I could go on to cite far too many other instances. Other nation-state actions are designed to create a technological and economic competitive advantage and gain access to intellectual property that would previously have been protected by patents, copyrights, trademarks and trade secrets. As we have seen with various terrorist groups, social media becomes a powerful tool of terror command and control –although that concept is quite different when applied to network organized groups like ISIS or Al Qaeda compared to more traditional hierarchical organizations like governments and the military.

Of course the hack-for-profit dwarfs all the rest. The scams are too numerous to elaborate upon, but the recent Goolligan Hack of Android phones took over about 1.3 million phones in a crude but effective hack to make money (at least \$500 k) by using those phones to download apps without the users knowledge. They also took over the user's Google accounts to keep the users from stopping them. The last attack (which is still ongoing) was not targeting the users, but was using them to target marketing companies. Other hackers ("Turkish Crime Family") are extorting Apple by claiming to have gained access to 559 million accounts and threatening to wipe their phones. Apple says don't worry.

I should take a moment here to disclose that I served in the past on National Advisory Boards to the CIA, the NSA, the FBI, and Homeland Security, but nothing that I mention in this talk is derived from information divulged in those meetings. Furthermore, the reason that I agreed to serve on these organizations was precisely the same motivation that I share with you here: we need to develop new policies and procedures to protect our privacy and civil liberties

We have gained so much, both socially and economically, from the transformation wrought by the application of IT to our industry, government and social systems. Like many of you, I could never go back. I could not give up the ability to ask my servant/spy for directions, to buy me a book, turn on my air conditioning, play my music, control the lights in my house, drive my car, show me what's happening at my home when I am thousands of miles away, or fire up my hot-tub on a cold night. Like many of you, I want it all, but I also want my privacy to be protected. I can already do all of the former but as for the latter? That ain't happenin' yet.

This will be the major IT challenge of the next few decades: how can we have all the power and control of our environment that we want and still maintain the democratic governments and personal liberties and privacies that current events indicate are in clear danger. Can it be done?

The answer, I believe, is in good hands. Many of you will be part of that process. You are all well and broadly trained to understand how IT is changing our world. You will be helping to design both the new technologies and the new policies that will define/transform our society into the something very different. Please, do it well. My children and grandchildren are counting on you.