How Do We Show k-12 Children and their Parents Engineering's Impact on Society

Going beyond the usual next big thing!

HOW can we better tell the world about technology?

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Consider this an exam for me and a challenge for you!

My Plan

- I’m going to start with a rant
  - I think we have divided the population into techies and the masses
  - I don’t like it
- Then I’ll present some ideas and examples
  - This will NOT be complete and definitive
- After that I am looking for feedback, positive and negative
  - I even want to hear if you don’t care
- Hopefully we can work toward some improvement
  - Perhaps even incite a few of you to join the cause

So let’s get started

- This will be a primitive presentation
  - No army of PowerPoint producers has been at work
  - No animation or video, but hopefully enough detail to keep me on track
- Let’s talk about our intended audience
  - It is students in k-12 and the adults in their community
  - Particularly those who use technology, but have no concept of how it works
  - Maybe some of them will be interested
  - Parents are at least as important as students
- Our audience is not:
  - Students from Quaker Valley School District (qvsd.org)
  - Most students from top high schools around the country
  - Kids in a FIRST robotics team

A Personal Observation

- Most people today don’t know much about how things work
  - They have been conditioned to believe that technology is not too complicated to understand
  - We have a lot guilt in allowing that to have happened
  - It happens to a lot of engineers as well
- Lots of people learn to work the user interfaces
  - There are those who never learn to set the clock display off of 12:00
  - Just because someone uses U-tube or Twitter doesn’t mean that they have a clue about how it works.
  - Learning to type with your thumbs might be an important skill, but it isn’t understanding
- Many, even lots of us here think our cars are too hard to understand
  - After all they have computers and many sensors
  - Doesn’t that make things impossible to understand?
  - Auto makers want us to believe cars are complex and they will take care of them
  - I’m not sure how Toyota feels this week!

More about Cars

- You didn’t ask, but are hybrids just marketing hype?
  - If they are more efficient, why is that so
- Efficiency of a gasoline engine depends upon compression ratio
  - Power depends upon compression ratio and displacement among other things
  - You want power for good acceleration
  - You cruise at low throttle
- Hybrids allow engines that can only power cruise
  - Electric Motors assist in acceleration (and retrieve energy in braking)
  - It’s a win, but it isn’t perfect
- What about a car driven only by electric motors
  - The engine only charges the batteries (still needs enough power for cruise)
  - It’s coming as the VOLT
- Beyond, look for diesel to replace gasoline (higher CR)
- Now, I’m not going to tell you about how your engine works
  - Even with sensors and computers it is just as understandable

What has changed

- We used to have “How Things Work” Books for kids
  - We had Erector sets that followed the Lincoln Logs and Tinker toys
  - Once your fingers could handle fine wire, you could wind a coil and build a crystal set
  - Hammers, saws, and blocks of wood could make things
- The details of how a car worked were not hidden
  - We learned about engines and how they worked, often by taking them apart
  - Lots of farm kids had even more experience and lots of machinery
- From spinning wheels to printing presses to steam shovels and locomotives one could learn about things
  - We weren’t told that it is too complicated to think about
- When we added fuel injection and emissions controls we told you that you couldn’t understand cars any more.
- The old way got kids interested in technical things. Now it is harder

About Engineers !

- We are proud of what we do
  - Our jobs tend to be creative and very useful to society
    - We innovate
    - We design
    - We enable things to happen
  - We want the world to think of us as good for society
    - We write a lot for ourselves which helps us create more new things
    - We deal with very complicated things l
      - Leading edge technologies, innovative products, new capability, standards, and complex technical design and tradeoffs
  - Well, we've not been good at letting people know about what we do
    - The Next Big Thing is often about some new capability and we love to brag
      - We teach people how to handle the user interface
    - We don't talk about how things work because it seems too complex
      - When we do, we use words people don't understand
    - We often take advocacy positions rather than presenting balanced views
      - We expect detractors will cover the alternatives
  - With help from industry and academia we've created a two tier world
    - There are the "techies" and there are the masses
  - It's time to turn things around but, as usual, things are hard to change

Permit me have another example

- **How should we talk about green power?**
- Let's start with Wind
  - Well, we can't have it every day, so what are the bounds
  - Is there an estimate of how much wind capacity we could have by some date
  - Even if we have 100% capacity, what percentage of the time does the wind blow strongly enough
  - For the other days we have to have capacity on standby
  - If the days are cloudy or if it is night, we won't have solar of any kind
  - So we must have non-wind and non-solar capacity on site
  - If 10% of the plants are down for maintenance, we need 111% of capacity to sit on standby
  - Even if wind is competitive cost wise when it runs, we have to pay for the standby capacity
  - That cost has to be included in the cost of electricity
  - So when you need standby, do you first cut the cheapest (coal) or the more expensive (natural gas)
- This is about reasonableness and sanity checks

- These are things that kids and parents can understand
- They don't learn this from the usual discussions of wind power
- They just hear from advocates or detractors

OK, even a last example

- Pacific Gas and Electric has gone GREEN
- They convinced the PUC to allow them “conservation rates”
  - The base rate is unchanged, covering the power, distribution, meter reading, profit, etc
  - Once you’ve paid for those things, the price goes UP and not DOWN
- Simply put, if I charged a plug-in electric car today, my rate would be $.45 per KWH
  - Yes, there will be an exception, as there is if you only have electric heat
- This isn’t engineering, but corporate greed and it’s hardly the only example
- It may turn up in the press that electric cars are too expensive to operate in California

The Next Big Thing !!!!

- Well, this is what we publicize
  - Lately social media, “real time” search, extreme broadband, I-pad, g-phone, Volt
    - You can add to the list your favorites if you want
    - Some of the functions are really neat
    - In fact some of them are even new
  - Is this stuff all important to the bulk of mankind?
    - Certainly NOT in the short term
  - So, what about technology is really important to mankind?
    - We don’t talk about that much because it is talking about what we already have
    - We don’t go on about the trash-bin of old technologies and filling the dumps with obsolete electronics
  - I think people would be interested in real information about the value of what engineers do
    - You could start in communication with the telegraph and end up with personal wireless communication even if you don’t yet know the value of an I-phone.
    - You could show who are included in the technology and who is left out.
    - You could talk about GPS and its help every day. Someday real-time traffic reports will be part of it
    - You could also talk about the terror threat it creates for the world
  - We probably need non-engineers to help here!

What is it that we need

- I think that we need a magazine for starters
  - This is an area which simply is NOT covered
  - It should have industry and other appropriate advertising
  - It should be free to public schools with encouragement to copy
  - It should be in newsstand and available for modest subscription prices
- We also need electronic presence
  - This should include all the magazine content, easily accessible
  - We also need to look at social media, email lists, and other paths to reach specific targets
  - We need to encourage comments, blogs, and perhaps wiki style content
- We need a few professional staff plus
  - We have to get both academics and practicing engineers to contribute
  - This, then means that we have to not punish them for doing so
  - In many cases, we need contributions from non-engineers such as social scientists, economists, etc.

OK, so who should own this?

- I’ve talked about explaining what we do and addressing how we have changed society
- So who is the “WE” who should do this
- Surely it isn’t an old guy who drives a tractor when he gets a chance
- It really will take a sizeable organization with some interest and resources
- My personal views is that it should be either IEEE or NAE
- I’ve tried to get the attention of IEEE, but am pretty frustrated there
- I’ll admit to not pushing on NAE, but I am comfortable going there is there is more than myself pushing this initiative
- Does anyone have any other likely homes for the movement?
- No, I’m not asking ECE DHA to be the owner, but perhaps a supporter

IEEE

- I’m comfortable there and know a lot of the key players
- They have a Society for Social Implications of Technology
  - This is NOT a possible partner, sadly, I’ve tried there over the years
- Potential homes are:
  - United States Activities
  - Educational Activities
  - or perhaps IEEE Corporate like Women in Engineering
- Any suggestions?
  - Which of these boards should I approach?
  - I’ll be farther along with the help of this exercise

- Or should I go to the National Academy?

NAE

- NAE is a wonderful organization
- They tend to put out studies
- They do not tend to have operational support for ongoing issues
- Still they might help find a home
- I am sure to get interest there, but not certain I’ll get much help

- Where else?

Thank You for your patience

- Now you can grade me, but let’s keep that somewhat private
  - I hope I got a passing grade!

- I hope that we have captured your inputs
  - I will get them added to the website with this presentation

- My contact is:
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Comments with replies

Keep it broad…all of engineering. Engineering, by doing things like cleaning water has saved more lives than any other profession.

> True, but will clean water engineering really turn kids on.

If it is broad who does this? ASEE?

> I don't know, I'm searching. IEEE has the size and mission, but not currently the will. What are ASEE's resources?

Kids want to save lives, change the world, make a difference. Kids have a perception of what they want to do and when they enter our curriculum they are disappointed.

> This just identified the problem. How do we make knowledge of engineering something that (some) kids want to know about.

Two problems: 1) Few students in high school inspired to go into engineering (a noble and exciting profession) and 2) ECE underestimates itself as a profession able to excite students and convince them to go to into ECE.

> Yes, but how do we change this.

What about a "benefactor" route? Is this like what Dean Kamen wants to do? You need a source of funding.

> Kamen is doing a wonderful job, but it has to reach all schools.

There is a website on "how stuff works" (http://www.howstuffworks.com/).

> Thanks, I hadn't looked at this. Currently it seems too shallow, but maybe we can figure out how to build depth. Maybe a WIKI approach?

We should keep this ECE centric. I want to know how to connect kids with ECE and choose ECE.

> I share that view, but as an engineer I've had to work well beyond ECE to solve problems, so I'm more generic

More Comments

Is the answer to push technology/engineering courses into High Schools along side science/math? If so who does this?

> Look at my reference to QVSD.ORG they are doing this in K-12. It was put in place by educators, not engineers.

Junior HS and HS students comes to our department and we ask them who wants to go into different disciplines? About 40% express an interest in CivE, 40% in MechE and few to EE. This may be a reflection of the types of projects/contests sponsored in HS (bridge building, robot building, etc.). (cf. IEEE efforts described to interest students in Engineering they all seem to focus on CivE, MechE, type projects not EE or ECE).

> High Tech is heavy in ECE. Can't we be smart enough to get projects in our field? Do they comprehend how our stuff works?

The problem is that few students have an interest in Engineering (2%). We do need to increase that number to increase the pool of ECEs as well. First Robotics events can be used if we are active to describe ECE to the First Robotics students. Ultimately, though, the key is to increase the 2% number for Engineering as a whole.

> FIRST gets kids to learn how robotics work. How about helping the world understand how our suff works.

Its "exposure". If all you see is computer games and you never write a line of code or a place to "tinker" you won't have an interest in Engineering in general or ECE in particular.

> That's what I'm talking about! Let's build some environments for experiment . Get attachments for computers that let them try things. How about a USB oscilloscope they could build? How about innovative challenges for what to do when you made one.

This is economic cycles. We used to worry about too many students (we didn't do anything and got many), we now worry about too few (and we're trying to recruit). This is really all about economic cycles.

> I'd like to be sympathetic, but look at the nationality mix in your students. Fewer than ever are US born. Sure we need the others.

We've not really done anything at the high school level. All we do is a "pitch" when students express an interest in Engineering and invite a speaker to our local high school.

> See QVSD.org, they have put a model program in place. The question is largely how to replicate it everywhere.

More Comments

There is computer/EE content even in the “mechanical/robotic” projects. We need to emphasize this.

This is certainly true. Probably half of the students in the FIRST program who go into engineering end up in ECE. I’d like to see more go into a broadened program which combines ECE and ME .. along with any other fields the student is interested in.

ECE has a PR/communications problem. There is no question about this. We have not heard a vision to solve this problem. What should we do and how can we access whether we are successful. This SHOULD be an ECEDHA effort that we mobilize our membership. Given the decline in HS students (in total) and those going into engineering we really must do something about this.

I agree that there is a problem. I don’t look to ECEDHA to solve it, but perhaps some can help identify who is best to help. Perhaps some can help move IEEE in the right direction. I’d like to work with anyone interested in that approach.

NSF has various programs (ITEST). We should look at those….but are we going after HS students, or JuniorHS students? Should we be going after the HS teachers? We can’t expect engineering to be inserted into the curriculum because the HS curriculum is already full. You have to understand the neighborhood of your HS and their curriculum and give them the tools to fulfill the requirements of their curriculum. This requires a long term commitment between universities and HS.

The program <QVSD.ORG> was put in place by a few educators. They worked with industry and academia (among them Cisco and I believe SJSU). It required modifications of the curriculum from bottom to top. It required teaching the teachers to teach technology. It also included introduction of technology in a sane and non-intrusive way into the classroom. It required extending out to the community and getting computers into the library (and sometimes when needed into individual homes) so that parents could come on board. Overall, it has to be in balance with the rest of the curriculum.

……

OK, I graduated from one of the schools that is now in QVSD. I was the only nerd in my class. There was one other who went to engineering school, but that was all. The most successful person in the class was the one who became a very successful NFL coach. It was eye opening to me when I saw the change which has been recognized by the state. My problem is that I know there are wonderful programs as you may also. How do we get them to be replicated across the country?

I am also a low level advisor to a First Robotics Team and recently went to my “first” competition. The students I work with are amazing and many headed to (converted to) engineering. Sure there are 2500 teams world-wide. How many school districts are there?