Richard W. Hamming

Learning to Learn

The Art of Doing Science and Engineering

Session 26: Experts

Expert Definition

"An expert is one who knows everything about nothing and a generalist is someone who knows nothing about everything."

An expert generally wins over a generalist

- Use of jargon (terms unfamiliar to the generalist)
- Invokes basic principles (potentially irrelevant to the discussion) to "snow" the generalist

---

Paradigm Shifts

***The Structure of Scientific Revolutions* by Thomas Kuhn**

- Talked of paradigms and examined the structure of scientific progress (based on series of assumptions)
- Discussed what it takes to create a "paradigm shift"
- Example: Relativity and quantum mechanics caused paradigm shifts (i.e. contradicted current paradigm)

Resistance to Change

Examples: articles and books were written against relativity and quantum mechanics

- "We didn't convert them, we outlived them."

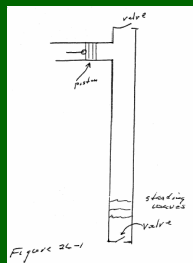**"Continental drift" theory by Thomas Dick**

- Took 100 years for this idea to be accepted

Many ideas are lost and later rediscovered, mainly due to an initial resistance to change

---

Raising Water 33 feet

Books said this feat was impossible due to the air pressure, and the Patent Office refused to issue a patent until it was actually demonstrated to them.

Figure 26-1

Similar feats:

- Wright Bros first flight
- Supersonic flight

It's Impossible!

All impossibility proofs rest on a series of assumptions which may or may not apply in a particular situation.

If an expert says you can do something, he is probably right. If he says it can't be done, find another expert.

- Experts can misidentify the problem by placing incorrect assumptions upon the problem (based on their experiences).

Reasons for this Lecture

1. **You need to identify the characteristics (faults and benefits) of an expert**
2. **I'm hoping you will be better than the average expert (and not block progress)**
3. **You will have to endure more changes than me (and experts don't like change).**
4. **I'm hoping that you won't be left behind after the next paradigm shift.**

The Source of New Ideas

Looking outside your field for new ideas
- Example: archeology – carbon dating came from physicists
- Einstein – submitted 5 papers while at patent office
- Telephone Co – undertaker built mechanical operator

Your dilemma:
- Ignore the crackpots outside of your field (where the new ideas come from) and miss the next big idea, or listen to the crackpots and waste all your time

The Flaws of the Experts

Already covered:
- Expert assumes he is right
- Doesn't consider his bias in judging new situations

Third flaw
- What made you successful in the past is likely to be counterproductive when applied at a later date

Yet another flaw
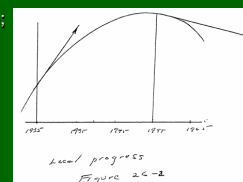- Experts never come out & say what you're doing wrong

The Challenge

Recognize what made you successful & try not to impose that criteria on others
- Example: saving computer time; cycles now take nanoseconds

Issue: getting in the way of the next generation

If asked: give your best answer, but don't stifle or disregard the views of subordinates

Experts Past Their Prime

Even the best fall victim
- Einstein opposed Quantum Mechanics
- Hamming didn't truly understand error-correcting code
- Newton was the last of the ancients

Experts freeze their knowledge at a certain point and refuse to incorporate new ideas
- But avoid being open to everything ("anything's possible" crowd); use probabilities & common sense

Wrapping-Up

Opposition to new ideas is enormous
- Took 10 years for error-correcting code to be adopted by Bell Labs

The more radical the idea, the stronger the opposition from the experts

But remember… sometimes the experts are right and the people with the new ideas are wrong

Human Nature

We don't work well in large groups, and there is an inherent distrust of the outsider

- Jargon helps keep the group small & the outsider out
- Example: departments/employees sabotaging the work of each other within the same company

Squabbling is not suitable for the future

- Ask: "should I be doing this or behaving this way?"
- Work against the instinct to protect the local group