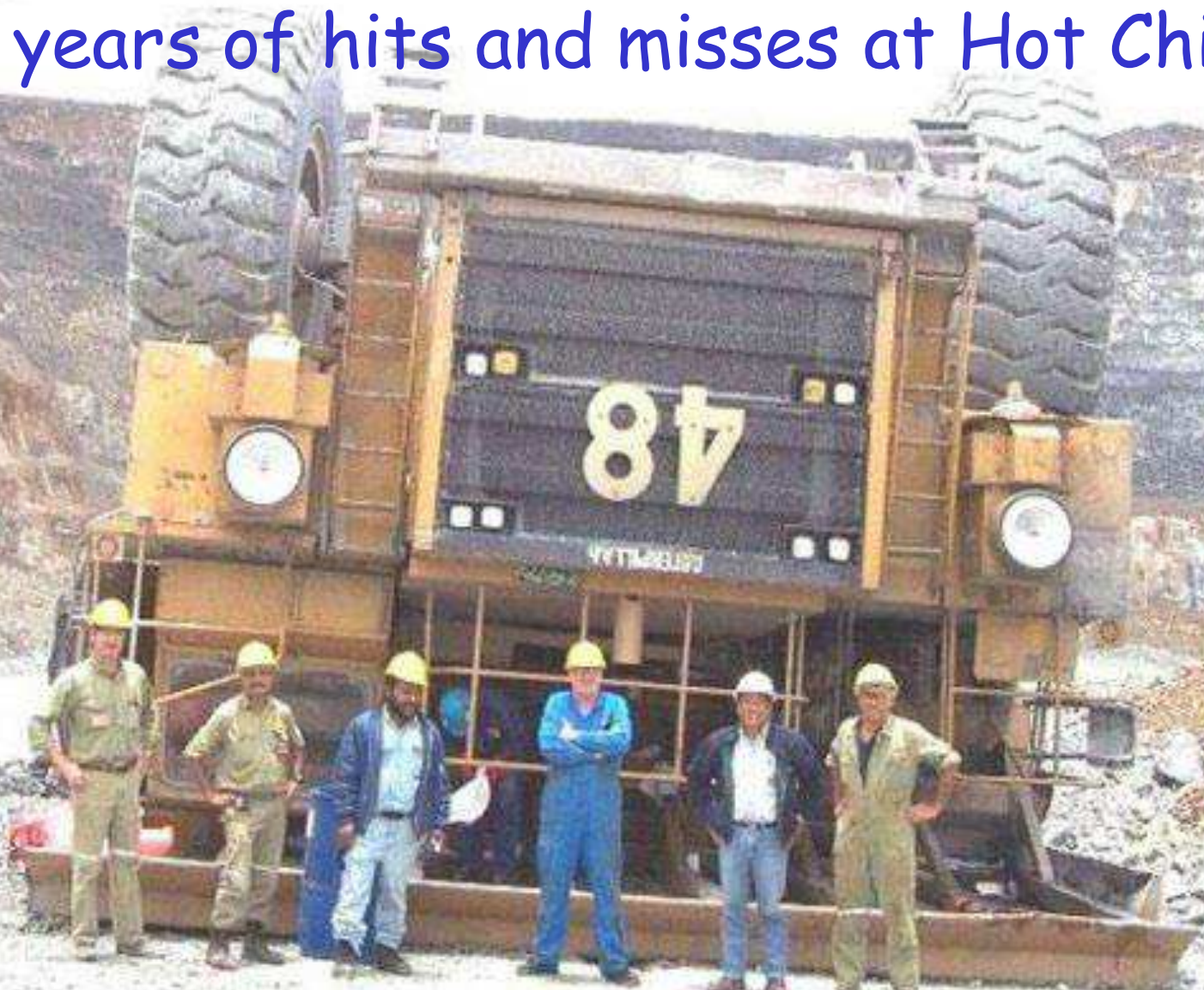# Ready, Fire, Aim:
20 years of hits and misses at Hot Chips

Nick Tredennick

Our Notorious Panelists

- Michael Slater
- Howard Sachs
- David Patterson
- John Mashey
- Dave Ditzel
- Nathan Brookwood

Panelist Bio Excerpts

The	Four	Will	For	Join	Primarily
this	or	manage	I	invite	and
at	who	that	feel	can	is
so	about	make	keynote	be	computer
take	other	it	titles	a	path
of	work	secondary	are	event	progress
and	have	half	too	know	subject
in	about	born	part	look	own
to	give	design	years	present	other
all	each	old	if	personal	between

Common In Most HC Presentations

- Non-possessive apostrophe
  - *1990's*
  - *ASIC's*
  - *CISC's*
  - *RISC's*
  - *LAN's*
  - *API's*
  - *IC's*
  - *Etc.*

Best HC Advice: Merced Panel 1997

What **I** Would Do!

- Can the whole Merced program forthwith
- Dump HP
- Hack up IA-32 to "64-bits" and call it "IA-64"
- Toss in a few extraneous instructions to throw AMD off track
- Whisper sweet nothings in Bill's ear to get him to use them
- Spend an extra 1% to stay a technology generation ahead
- Control the SRAM and DRAM suppliers by intimidation
- Employ market-domination-through-dirty-tricks campaigns
- Instill FUD in consumers with hyperbolic adds at Super Bowl
- Milk that sucker (IA-32) for the next 25 years

Best HC Summary: Merced Panel 1997

Why?

- You're sitting on top of the most valuable architectural franchise ever known to mankind – why risk screwing it up?

- We've clearly established zero correlation between ISA technical merit and revenue — or actually, maybe we've established an inverse correlation.

- You're not going to get significantly more out of a new ISA's than current (or slightly enhanced) RISC's already get — and they're clearly no threat.

- All ISA effects are dwarfed by a one technology generation.

- In the big scheme of things, the ISA just doesn't matter enough — the big gains are elsewhere.

Keith Diefendorff

Best HC Slogan: 1998 Panel

Was: "Can Microsoft be Stopped?"

"All that is necessary for the
triumph of Microsoft is that
good people do nothing"

—Anon

Instruction-Set Compatibility

"While the need for preserving compatibility will remain a major consideration in the short term, I believe that its long-term influence will be less than some people think."

    – Maurice V. Wilkes, AFIPS, 1972 (talking about computing in the early '50s)

Best Wishful Thinking: HC 11

- "Not having binary compatibility (legacy) requirements opens the door for innovation."

- ...

- "An architecture is only as good as its implementations, stay tuned for chip disclosures."

Memory and Logic

"The onrush of large-scale integration has now voided the technological distinction between logic and memory; their historical packaging incompatibility and speed mismatch have vanished."

– *Tien Chi Chen, AFIPS, 1972*

Lessons After Twenty Years

- Situation
  - *The technology is first-rate*
  - *The engineering is outstanding*
  - *Computer engineering is swept by fads*
  - *We are "fooled by randomness"*
- Result
  - *Progress is positive (by epsilon)*
  - *Management may or may not be inept*
  - *Failures are never eliminated*
- Causes
  - *Computer Architecture isn't science*
  - *Moore's-law-progress distorts results*
  - *The "Elvis and the nerds" problem*
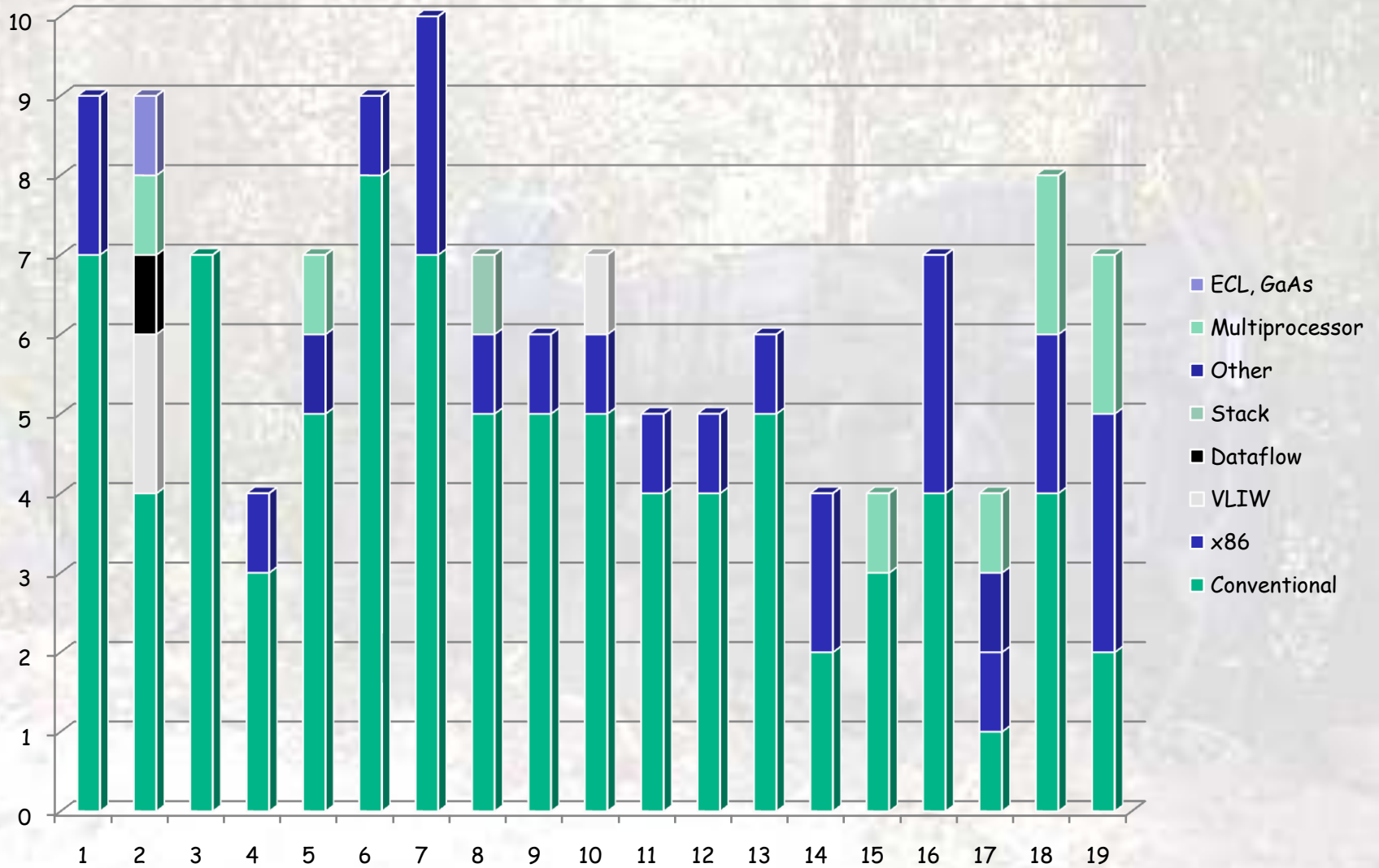
Computer Architecture Isn't Science

- ## Theoretical base
  - *There is none*

- ## "Computer architects"
  - *Propose designs*
  - *Run "anti-experiments"*
  - *Benchmark their own work*
  - *Report (advocate) the results*
    - All proposals are better than something
      - *Care in selecting and measuring competitors*
    - No failures reported

The Anti-Experiment

- Variable
  - *Compiler*
  - *Registers*
  - *Bus interface*
  - *Instruction set*
  - *Memory hierarchy*
  - *Interrupt mechanisms*
  - *Semiconductor process*
  - *Etc.*
- Fixed
  - *<u>Name</u> of the benchmark*

This Is Progress?

Legend:
- ECL, GaAs
- Multiprocessor
- Other
- Stack
- Dataflow
- VLIW
- x86
- Conventional

We've Eliminated Nothing

- Uniprocessor
- Multiprocessor
- VLIW
- Dataflow/Systolic
- Asynchronous/Clockless
- GaAs/ECL
- Zero-, one-, two-, three-address

Instruction Formats

"The most serious obstacles to a generally acceptable machine language are (1) the rigid formats for program and operands..."

– R. S. Barton, IFIP Congress, 1965

Three-Address Instructions

"Three address codes had many advocates who claimed that compared with single address codes they led to more natural programming…It always seemed to me that the argument for three address codes was emotional rather than scientific and I was not surprised when eventually they disappeared."

– *Maurice V. Wilkes, AFIPS, 1972 (talking about computing in the early '50s)*
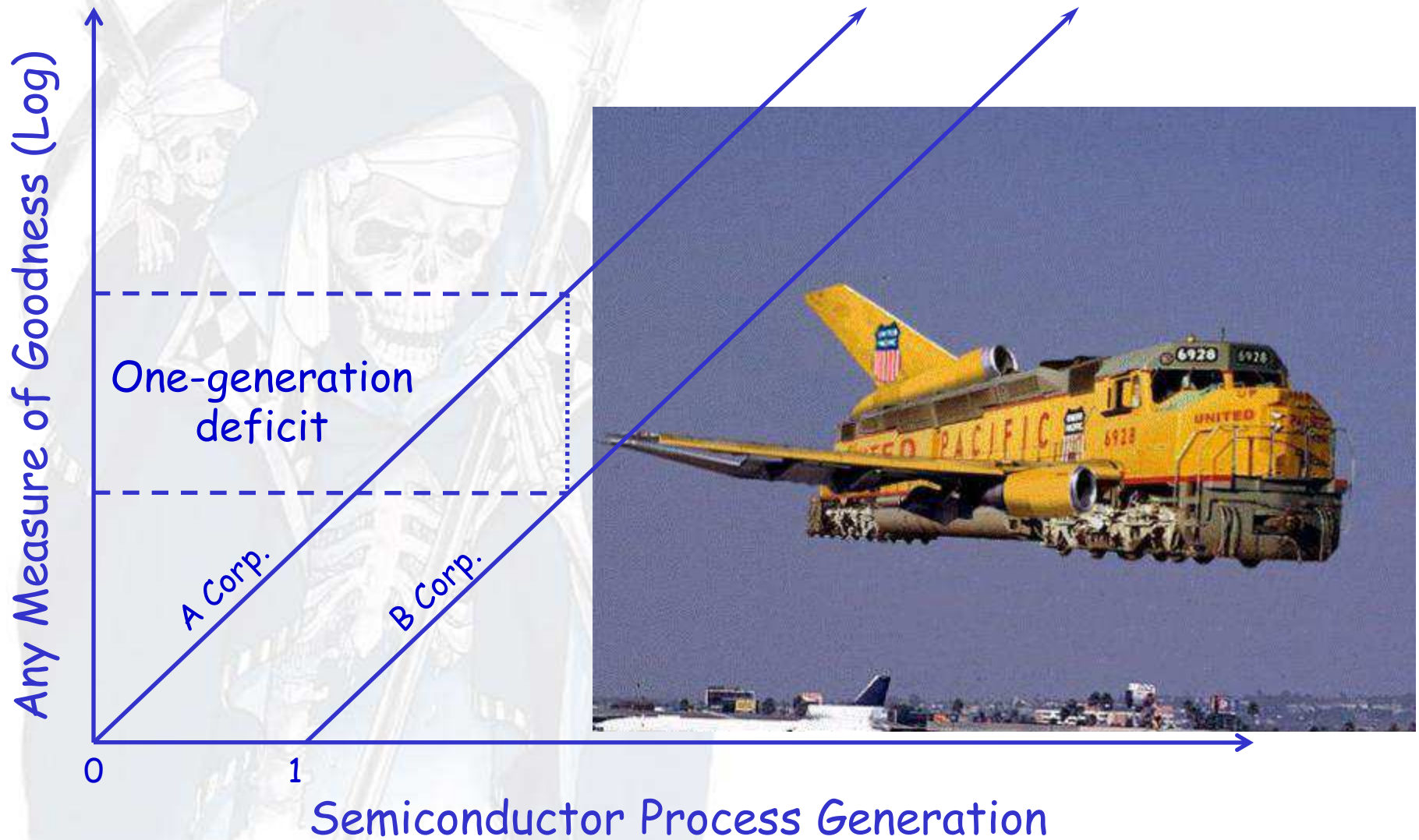
R&D Vectors
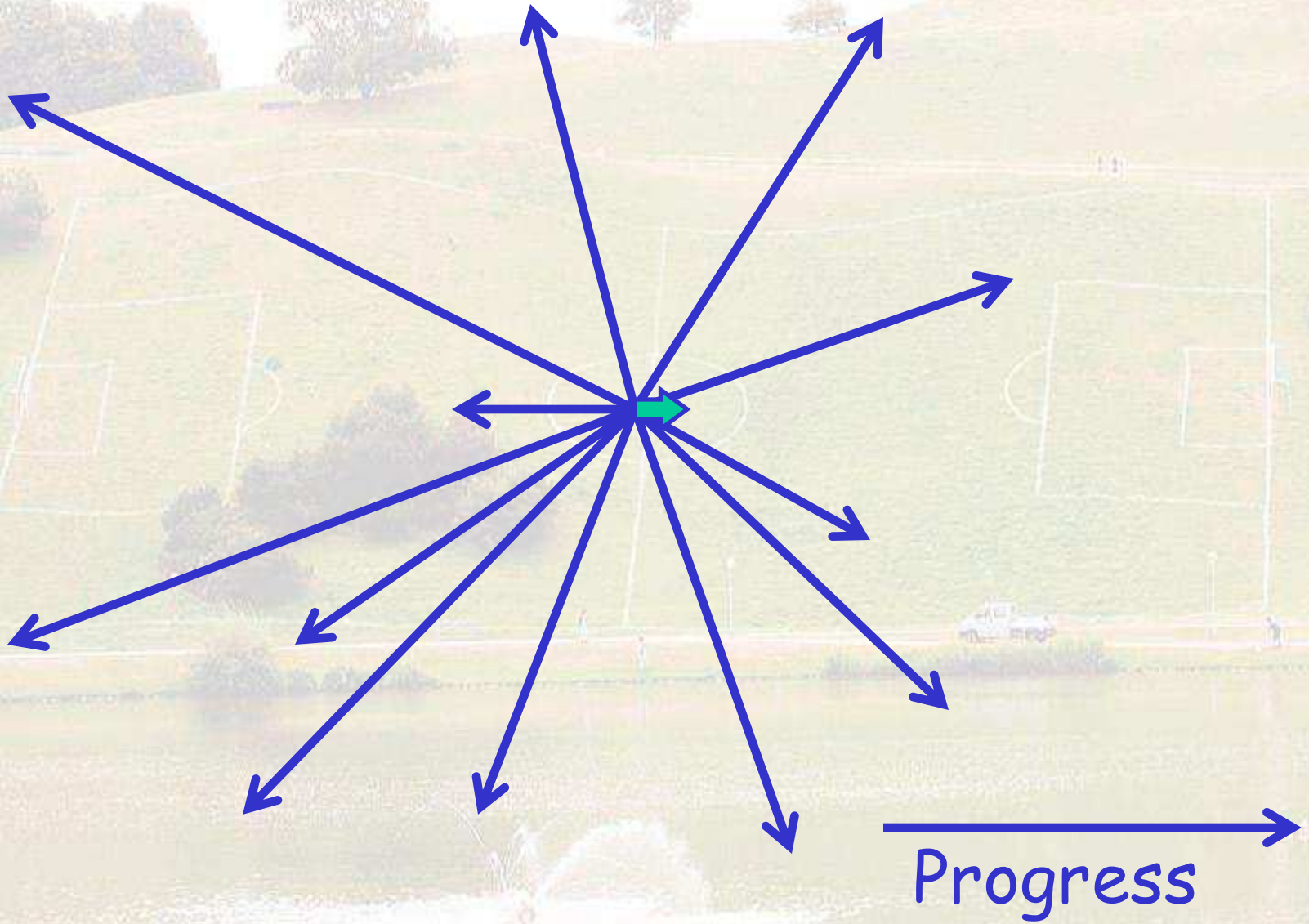
Progress

Moore's-law progress distorts results

- Everything works
- Even incompetent management may not prevent success
- Engineering design is consistently excellent

Behind The Technology Curve

Any Measure of Goodness (Log) (vertical axis)

One-generation deficit

A Corp.

B Corp.

0   1

Semiconductor Process Generation

Multiprocessing Proof of Concept: 300M

Floating-Point Instructions

"Oddly enough, some numerical analysts opposed the introduction of floating point arithmetic on the grounds that floating point operation was treacherous to the unwary and that programmers would get themselves into trouble by misusing it."

– Maurice V. Wilkes, AFIPS, 1972 (talking about computing in the early '50s)

Conclusion

"Surgeons can bury their mistakes, but architects can only plant ivy."

– *Frank Lloyd Wright*

(May be paraphrased)