

## Lynn Conway's IBM Talk-Notes, June 23, 2021:

### Opening:

Many thanks Dario for your kind introduction ... It's wonderful to join you today to help welcome and share ideas with IBM's 2021 class of Research Interns.

Having started my own career at IBM research back in 1964 ... and as someone whose research interns were key contributors at Xerox PARC during the 1970s, I can only imagine the exciting times ahead for you all!

Also, welcome to the other IBMers attending today. It's been a joy to reconnect with IBM this past year ... and build new friendships in the company ... it's felt like finally 'coming home'.

Setting the stage for our conversations today ... Think of me as a "voice from the past" ... being 83 years old now (I remember Pearl Harbor), I've lived through many tumultuous times ... it's fun to share stories about those adventures ... and the many hard lessons we learned back then.

To help frame the narrative, we'll begin with an epiphany I experienced in 2013 ... we'll then reflect on the motives, methods and meanings of the 1970's revolution in VLSI chip design that I was involved in ... we'll then visualize 'where we are today', a time of accelerating techno-social change ... and conclude with some words that might prove helpful guides into the future.

First let's go back to 2013 . . .

**The Many Shades of Out**  
**Reflections on the VLSI revolution**  
**Visualizing where we are today**  
**What words will you leave to guide them**

## **The Many Shades of ‘Out’, by Lynn Conway:**

On a sultry June afternoon, as my husband and I walked towards the White House, I reflected back on my gender transition in '68.

Shamed as a social outcast, I'd lost family, friends and all social support. Fired by IBM, I'd lost a promising research career. In many cities I could be arrested, or worse yet, institutionalized.

Evading those fates, I completed my transition, took on a secret new identity, and started all over as a contract programmer. Any 'outing' and I'd have become unemployable, perhaps even forced onto the streets . . .

So, fear channeled me into 'stealth-mode'. And for over 30 years I covered my past, living as if I were a spy in my own country.

But it was now June 13, 2013 . . . My husband Charlie and I were joining many other advocates at the President's White House Reception for LGBT Pride Month. The air was full of joy ... and as we awaited the President I reflected further.

Decades before in the 1970s, when I was hidden in the back-rooms of Xerox Palo Alto Research Center and launching innovations as the hidden-hand behind the VLSI microelectronics revolution, I didn't mind being invisible in my field or that no one had a clue what I was doing . . . I was thrilled to even have a job.

But I'd been 'out' now since 2000 . . . or so I'd thought: out on the Internet to reveal my past to colleagues, out as a trans advocate and an activist against psychiatry's pathologization of gender variance.

However, 'out' has many shades of grey -- and even in recent years I kept on shyly holding back, 'covering' in the darker shadows. Although times had changed, I'd clung to old habits.

Down through the decades no one could explain how the VLSI revolution actually happened. The results were simply taken for granted. Although I'd gained vital knowledge about generating such paradigm shifts, I feared my personal history would loom large in folk's minds and obscure any attempt at explanation.

So, it wasn't till 2012 that I got up the nerve to publish a memoir and begin revealing how the VLSI revolution came about . . .

There was a sudden buzz as the president entered the room. I glanced around and took in the joyful vibes. As he began to speak, I grasped how far we'd come. Times had more than changed: a fresh wind was sweeping through our society, especially amongst younger generations.

Then I thought of the millions of other LGBT people out there. I tried to envision their lifelong struggles against ostracism, their losses of families and employment, their oppression by having to 'cover', while not being known for who they were, what they'd done, who they loved or who loved them.

In a flash, I saw the vastness of the suffering . . . Then it hit me: We've come so far so fast that many others could now begin uncovering too!

After all, freedom isn't just an external concept framed by our laws. It's a gift of the spirit that we must give ourselves, by going towards the brighter shades of 'out'.

So ... now let's go back in time ... and reflect on the VLSI design revolution.

Like, what was that all about?

## The VLSI Revolution: Motives, Methods and Meanings:

I've reflected in detail on the VLSI revolution in my 2012 essay "[Reminiscences of the VLSI Revolution](#)" ... in recent talks about "[An Invisible Woman: The Inside Story Behind the Microelectronic Computing Revolution](#)" ... and in a 2018 *IEEE Computer* essay titled "[The Disappeared: Beyond Winning and Losing](#)". You'll find links to all that in my website [www.lynnconway.com](http://www.lynnconway.com)

But here today, I'd like to compress and help visualize events at a meta-level, by revealing some underlying motives, methods and meanings of it all.

In 1976, I was living in the 'computing-future' at Xerox PARC: We had Alto PC's (with graphic display, mouse), access to ethernet, servers, laser printers, & Arpanet I also found myself, together with some key mentors (Bert Sutherland at Xerox PARC, Ivan Sutherland and Carver Mead at Caltech), scouting out on a frontier that almost no one knew existed.

The new Intel microprocessors had a few thousand transistors ... but the rapid MOS density-scaling (X2 every 2 years) called "**Moore's Law**" held the promise of 1m transistors/chip by 1990 . . . I.e., computer-power on the order of the ACS-1 supercomputer I'd worked on at IBM. This visualization was "electrifying"!

However, the only computer architects designing such machines were a few employed by the Semiconductor Plants (analogous to having the authors of novels employed by Printing Plants).

Worse yet, the 'artwork' for maskmaking was done by hand cutting giant pieces of rubylith ... mimicking early etched block-prints before the innovation of moveable-type printing! Even though every design and fab process specialty was highly optimized, the overall operational-model was trapped by siloed hyper-complexities ... and couldn't scale much further.

Thus arose a motive: Why couldn't there be a separation between design and fabrication, so that designers outside the Semiconductor industry could create chip layouts and electronically send them to printing plants (later called 'foundries') for printing and packaging? The mantra became "**The freedom of the Silicon Press**"!

And a method: **Why not toss out all those complexities** and build up a simple, robust chip design methodology that could easily be learned by digital system designers to create digital system chip layouts using Alto PC's? **Think LEGOs!**

So, we went prospecting ... and quickly struck gold in this unexplored territory. In '77 we began evolving a digital textbook ... which became "**Introduction to VLSI systems**" to share emerging results and begin a movement via the Arpanet.

Among the key results were a set of rectilinear **Scalable VLSI Design Rules** that I invented. Based on dimensionless inequality equations, they enabled chip design layouts to be digitally encoded, scaled, reused and open-source shared as Moore's law advanced. **Show MC book, Show design rules**

As a visiting Assoc. Prof. **at MIT in the fall of '78, I taught a university course** on the new methods in which students learned to design chips and then did team design projects which were quickly fabricated after the course. The results proved out the methods and stunned Silicon Valley's cognoscenti. **Show MIT 78 wafer**

In the spring of '79, several research university EECS departments clamored to replicate the MIT course. Suddenly, I got the idea of creating an Arpanet-based e-commerce server-system that could take in many chips designs and array them within larger multi-project-wafers, enabling many users to efficiently access fabrication. **(Think of receiving graphical-images for T-shirts, printing them, and sending them back to the users.)** My team leapt to the occasion, and began building the server-software.

Holding our breaths, **we announced “MPC79”**. 12 research universities launched “MIT-like” VLSI courses that fall and submitted designs for fab and test. It became a **huge Arpanet ‘happening’**, involving 129 budding VLSI designers!

**MPC79 was the breakout of the revolution.** DARPA began massive funding of VLSI architectural and design tool research based on our design methods, and institutionalized the MPC79 e-commerce infrastructure as the MOSIS System, which for decades served the VLSI research community. By 82/83, 113 universities around the world offered “Mead-Conway” VLSI design courses.  
**Show MCP79 wafer and ImpDoc**

The ever-advancing MOS scaling now **marched in techno-social synchrony** with the ever-evolving digitalsystem architectures and increasingly powerful design tools. Silicon Valley VCs took the bait. VLSI-based startups were everywhere. The rest is history.

However, the revolution had all seemed **elite institutionally-planned and launched**, coming as it appeared to “**from MIT, PARC, then DARPA**”. It worked so well that high-tech just ran with it, without a clue to how it was pulled-off, much less who ... *out there in the back rooms* ... had done it!

**And I wonder: could it have happened any other way?**

## Visualizing Where We Are Today:

Let's now take a few minutes . . . and together visualize the seas YOU'LL soon be sailing. Especially since you're embarking in an era of accelerating social change, where our evolving technologies connect and empower us in previously-unimagined ways.

In the emerging "Techno-Social Age", waves of spontaneous shared-team-consciousnesses will rapidly arise, evolve and interact. Contributing inside and across such-teams, you'll encounter increasingly-diverse, often conflicting, ways of being and doing . . . giving ever-deepening meaning to the old maxim "Consistency is for Small Minds".

By focusing on building your social-capital as learners, contributors, innovators, leaders and explorers . . . instead of merely seeking money, possessions, formal positions and the trappings of power . . . you'll expand your social-agility, and your life-long opportunities to team-up with cool people, go exploring, have exciting adventures, and leave tracks behind.

And by embracing . . . rather than fearing accelerating social change . . . you'll experience a most-wondrous (but scary) effect: "*You'll live far further into the unfolding techno-social-future than you ever dared dream!*"

Up to now, we've thought it'd be cool to live beyond life expectancy . . . But now we must ask: How can we stay out on the front of those social waves?

From the perspective of 83 years . . . I realize that "my guides" to learning and to embracing change have been sets of "special words" left by earlier pathfinders . . . people whose life-stories have deeply touched me . . . And whose words resonated ever-more-clearly *as I aged*.

I'd like to share some of those with you by reading a "Quoem" that I call:

"What Words Will You Leave to Guide Them"

## “What Words Will You Leave to Guide Them”:

[Winston Churchill](#) gives us a compass for our life-journeys when he says, *“The farther backward you can look, the farther forward you can see.”*

And as [Steve Jobs](#) observes, *“Your time is limited, so don't waste it living someone else's life.”*

[Grace Hopper](#) reminds us, as we're about to set sail, that *“A ship in port is safe, but that's not what ships are built for.”*

And as ‘The Great One’ [Wayne Gretzky](#) says, *“You miss 100 percent of the shots you don't take!”*

Then too, as social philosopher [Eric Hoffer](#) reflects: *“In a world of change, the learners shall inherit the earth, while the learned shall find themselves perfectly suited for a world that no longer exists!”*

So, do be careful! Don't just build ‘expertise’ to rest on as time passes. As [B. B. King](#) keenly observed: *“The beautiful thing about learning is nobody can take it away from you!”*

Thus oriented, pay heed to Intel's Co-Founder [Bob Noyce](#), and: *“Don't be ‘Encumbered’ by History ... Go off and do something wonderful.”*

During dangerous voyages, be stoically realistic, yet passionately persistent, for as historian and activist [Bertha Calloway](#) reminds us: *“We cannot direct the wind, but we can adjust the sails.”*

In extrema, as gonzo journalist [Hunter S. Thompson](#) coolly observes, *“When the going gets weird, the weird turn pro!”*

That can get pretty-wild, but you can come to love it. As [Kurt Vonnegut](#) says, *“I want to stay as close to the edge as I can without going over. Out on the edge you see all kinds of things you can't see from the center.”*

Sometimes, you can even step across the edge, my own perspective being: *“If you want to change the future, start living as if you're already there!”*

In her poem "[A Summer's Day](#)" [Mary Oliver](#) poses perhaps the ultimate question:

*"Tell me, what else should I have done? Doesn't everything die at last, and too soon? Tell me, what is it you plan to do with your one wild and precious life?"* . . .

During your explorations . . . *always mentor AND learn from* the young ones who come after you . . . eager to learn the ropes and join your crews . . . for your fates are bound-up-together, in the same ships, atop a deep social ocean.

Finally, thinking further ahead to when YOU are 83, what words will YOU leave to guide the young, and their descendants . . . as they nervously gear-up to surf the wondrous-waves of life's unfolding experiences? What words?

Then I remember 'The Words' . . . words left to us by the legendary French [aviator](#) and [writer](#), [Antoine de Saint-Exupéry](#):

*"If you want to build a ship, don't drum up people to collect wood and don't assign them tasks and work, but rather teach them to long for the endless immensity of the sea."*

The chance to share these words with you, at this special time in your lives, means more to me than you can possibly imagine . . . and I wish you all good fortune in the adventures ahead!

... Thank you ...