The Information Revolution: Reality or Hype?

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Revolutions

Ruth Rosen, Houston Chronicle, January 2000:

> "Bursts of artillery fire, mass strikes, massacred protesters, and bomb explosions are our usual images of revolutions. Yet some revolutions are harder to recognize: no cataclysms mark their beginnings or ends, no casualties are left lying in pools of blood. Although people may suffer greatly, their pain is hidden."

Revolutions

- Political revolutions:
  - The American revolution
  - The French revolution
  - The Russian revolution
- Economic revolutions
  - The agricultural revolution
  - The industrial revolution
- Cultural revolutions
  - The invention of writing
  - The invention of printing

A Revolution Is Coming

"Civilization now stands at one of those great historic junctures that arise only a few times in a millennium. The central organizing forces of society are being reshaped by powerful new technologies of light and silicon. The next few decades will witness profound alterations not only in the way we live, work, entertain, and inform ourselves, but also in the strategies of business, the dynamic of the marketplace, the competition between companies and between countries, the process of wealth creation, and even the role of government. The Digital Revolution is going to transform the personal future of everyone."

D. Burstein and D. Kline, Road Warriors, 1995

"A new technology is opening up new vistas for democracy, education, and personal enrichment. The Government will be a living thing to its citizens instead of an abstract and unseen force. Elected representatives will not be able to evade their responsibilities to those who put them in office. The new medium will be like a gigantic school, and have a greater student body than all our universities put together."

Radio Broadcast Magazine, 1922

We Are Drowning in Hype

D. Pearl, Futurist Schlock, WSJ, Sep. 1995:

> "The Internet promises to change society as we know it, letting people work wherever they want, reinventing government. and creating new communities. Of course, people said the same thing about the telephone a hundred years ago. Futurists predicted that the telephone would, among other things, bring peace on earth and eliminate Southern accents."

Dot-coms Soared, Dot-Coms Crashed

Fortune Magazine, October 2000:

> "What a cruel illusion it all turned out to be. Stoked by the false promise of office foosball and a lot of irrational exhibitionism, the dot-com phenomenon proved to be shot through with phoniness–an apparition within a hologram wrapped inside a specter of a mirage, with some tulip mania to boot."

Technology Can Be Underestimated

- Thomas Watson, Sr., IBM, 1943: "I think there is a world market for maybe five computers."
- Popular Mechanics, 1949: "Computers in the future may weigh no more than 1.5 tons."
- Business books editor, Prentice Hall, 1957: "I have traveled the length and breadth of this country and talked with the best people, and I can assure you that data processing is a fad that won't last out the year."
- Ken Olson, Digital Equipment Corporation, 1977: "There is no reason anyone would want a computer in their home."

Science Can Be Underestimated

Michael Riordan and Lilian Hoddeson, Crystal Fire, 1997:

> At an annual dinner in the early 1900s, physicists working at the Cavendish Laboratory in Cambridge–who were involved in the very conception of the field of electronics–commonly gave one another the following toast: "To the electron; may it never be of any use to anybody."

Exponential Explosion

An old story:

The Emperor of China was totally infatuated with this new game of chess that had been invented for him. He was so grateful to the inventor that he came to him and said, "I'll give you anything you want in the kingdom as a tribute for this wonderful game you gave me."

And the inventor said, "Well, all I want is some rice. I want one grain of rice on the first square of the chess board, which has 64 squares, then I want two grains of rice on the second square. Four grains of rice on the third square, eight grains of rice on the fourth square and so on."

And the Emperor happily granted this apparently modest request, and everything went fine for the first 32 squares. After 32 squares, he could produce the several billion grains of rice fairly well on a quarter square mile of rice fields. But after the first 32 squares, things began to get interesting.

Why Is It Happening So Fast?

The phenomenon of exponential progress

- Every year or two, the amount of processing speed you can buy for a dollar doubles
- Every year or two, the amount of memory you can buy for a dollar doubles
- It's been going on for several decades
- It's likely to keep going on for at least one more

An Analogy

Grasping the rate of progress:

- Pioneers' covered wagon: 20 miles a day
- Early automobiles: 20 miles an hour
- Supersonic aircraft: 20 miles a minute

That's a factor of 1000!

Squeeze that into 10 or 15 years. That's how fast information technology is moving.

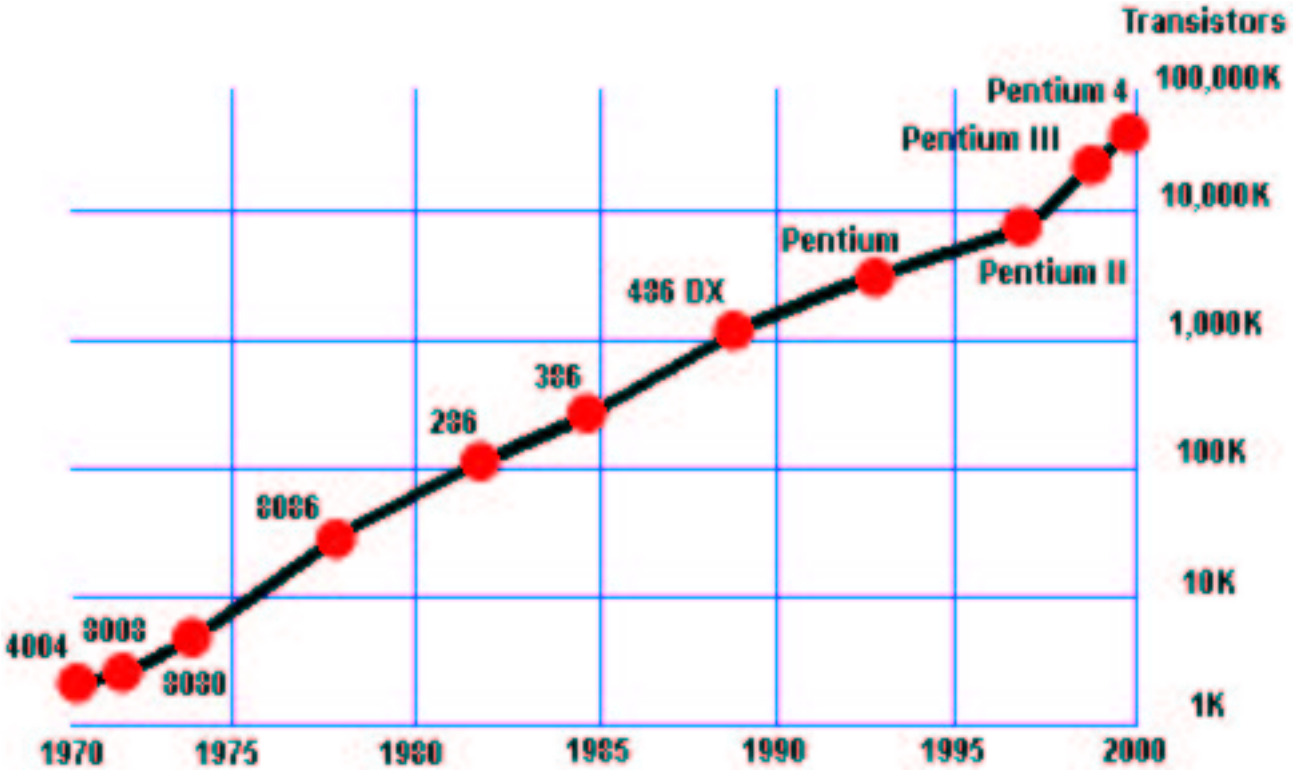
If, over the past 30 years, transportation technology had improved at the same rate as information technology with respect to size, cost, performance, and energy efficiency, then an automobile would ...

- be the size of a toaster
- cost $200
- go 100,000 miles per hour
- travel 150,000 miles on a gallon of fuel

Fact: Today's laptop *blows away* the university computer center of only 20 years ago! In fact, today's $2.50 singing Hallmark card is more powerful than the ENIAC, the first computer, built in 1946.

Moore's Law

Gordon Moore (co-founder of Intel) predicted in 1965 that the transistor density of semiconductor chips would double roughly every 18 months.



The result: increased performance, decreased cost

Why Is Computing Important?

Alfred North Whitehead, 19th Century British mathematician:

> "Civilization advances by extending the number of important operations which we can perform without thinking about them."

Ubiquity

- About 30 years ago, in 1970, there were only about 50,000 computers in existence world-wide.
- In 1990, after a remarkable period of growth, 50,000 computers were being sold every business day.
- In 1995, 50,000 were being manufactured and sold every ten hours.
- In 1999, 50,000 were being manufactured and sold every four hours.

Fact: One billion personal computers have been sold in the past 20 years–compared with 300 million cars.

Disk Storage

- **That was then**: 1956 – RAMAC, 5MB on two-foot-wide platters in a refrigerator-sized device.

- **This is now**: 1998 – MicroDrive, 1GB on one-inch-wide platters in a matchbox-sized device.

Comparison: The MicroDrive is 13,000,000 times more efficient than the RAMAC.

Connectivity

N. Stephenson, Wired, 1996: "Wires warp cyberspace in the same way wormholes warp physical space: the two points at opposite end of a wire are, for information purposes, the same point, even if they are on opposite sides of the planet."

- Alexander Graham Bell, 1876: "Mr. Watson, come here. I want you."
- Samuel Morse, 1844: "What hath God wrought!"
- Mother Shipton, prophetess, early 16th century: "Around the world thoughts shall fly, in the twinkling of an eye."

This Is Just The Beginning

Robert Fulford:

> "I wonder what the townspeople were thinking when they were seeing their first car. Did they have any idea how the invention of the automobile would change the way we live, even affecting the air we breath? For years people called it 'horseless carriage', which suggests they believed it was merely a mechanical replica of something they already knew.
>
> When we send words over the Internet we call it 'e-mail'. That is our parallel to 'horseless carriage'. The term implies that the new technology simply transmits letters like the ones we have always sent in envelopes. But it is possible that we are as innocent as those who thought cars would fit easily into our lives. Today no one knows how the new technology will change society.

A New Medium of Communication

Thomas E. Weber, WSJ, 2000: "E-mail is a form unto itself, not quite like a letter, but not like a phone call either."

L. Sproul and S. Kiesler, 1986: Email is written in a conversational style, but lacks the clues that tone of voice and facial expression provides.

Solution: *MoodWatch*–an "emotional spellchecker" that scans for vitriol instead of typos–included in Eudora 5.0 (`www.eudora.com`).

Oops!

NYT, Oct. 1997:

> As a first-year associate in a large Wall Street law firm, Gilman Miller was so wrapped up in work one day that he didn't have time for a two-minute break to call his girlfriend. He decided to send her an email message to let her know that she was on his mind.
>
> "Just thinking of you," he typed. And he send the message without noticing that he had mistakenly clicked on two addresses, including one that dispatched his little note to all 1,000 of his fellow employees.
>
> In a short time, the phone calls began. Colleagues started poking their heads in to Mr. Miller's office to thank him for expressing his hidden feelings. The computer messages began arriving , too: "I didn't know you cared." and "I was just thinking of you, too" and "Who are you?". Mr Miller was instantly famous.

From New York to New Zealand

Associated Press, Dec. 2001:

> After barely escaping from the 87th floor of the World Trade Center's north tower on Sept. 11, Adam Mayblum poured out his heart in an email sent to family and friends. Less than 24 hours after he wrote his account of fleeing the burning tower and sent it to about 25 people, Mayblum received 100 replies–most from people he has never met. "Within 24 hours it was ridiculous. I was getting responses from New Zealand."
>
> Since then, thousands of strangers from around the world have responded to his harrowing story. "You don't know me," one women wrote. "My son-in-law forwarded your story to me and I'm not sure who sent it to him." Mayblum tried to reply to each response, but stopped after 500. He received prayers from Texas, praise from Seattle, best wishes from London, and apologies for poor English from Paris.

Flooded with E-Mail?

WSJ, Sep. 2000:

> Jamie Rosen, chairman and COO of Comet Systems Inc., an Internet software company in New York, spent several hours at his office this past weekend respnding to e-mails he didn't have time to answer the previous week. He expects at least as much e-mail this week, so by next weekend he'll be plowing through yet another pile of unanswered messages.
>
> He acknowledge that, "the more you use and respond to e-mail, the more of it you generate". He is beginning to wonder whether e-mail has become more of a burden than benefit–lowering his productivity, rather than boosting it.
>
> "I cannot keep up, and cannot imagine how executives in larger organizations do," say Mr. Rosen.

World-Wide Web

The world's information at your fingertips!

Unforeseen consequence: anyone can publish!

Jaron Lanier, Wired, January 1998:

> "The Web has created the most precise mirror of people as a whole that we've yet had. It is not a summary prepared by a social scientist or an elite think tank. It is not the story of an era, condensed by a romantic idealist or a sneering cynic. It is the real us, available for direct inspection for the first time. Our collective window shades are now open. We see the mundanity, the avarice, the ugliness, the perversity, the loneliness, the love, the inspiration, the serendipity, and the tenderness that manifest in humanity. Seen in proportion we can breath a sigh of relief. We are basically OK."

The Big Book of Mischief

1. Buying Explosives and Propellants
    - Black Powder
    - Pyrodex
    - Rocket Engine Powder
    - Rifle/Shotgun Powder
    - Flash Powder
    - Ammonium Nitrate
2. Acquiring Chemicals
3. Techniques for Picking Locks
4. Advanced Uses for Explosives

Virtual Life

On May 14, 2001, Kaycee Nicole Swenson, an effervescent 19-year old, died unexpectedly from complications surrounding leukemia, which she has been battling for nearly two years. Kaycee, an unyieldingly optimistic high school basketball star, had chronicled her remissions and relapses in her online diary, or Weblog, which she had dubbed Living Colours.

For nearly a year, thousands of people went to the web site to follow her travails. Many came to feel as if they knew her, and a few talked with her regularly on the phone. On May 15, 2001, when Kaycee's online followers went to her weblog, they found a small image of a rose, accompanied by an announcement of her death.

But: A few days after the death announcement, Debbie Swenson, a 40-year old homemaker, confessed to having invented the life and death of Kaycee. Apparently, when some of Kaycee's followers insisted on visiting her, Ms. Swenson decided on a sudden death.

Role Theory

Basic Premise: We have no "self" as much. Our selves are merely the mask we were in response to social situations in which we find ourselves.

Stuart Jeffriess, The Guardian, July 2001:

> "Witness Jonathan Lebed, a 14-year old kind from Cedar Grove, NJ, made $800,000 in 2000, trading on the stock market. He posted hundreds of messges under different names on Yahoo! finance message boards recommending stocks he has already bought. In advance of posting the messages, he left sell orders in case his shares rose in price–which they mostly did."

Michael Lewis, NYT, July 2001:

> "Marcus Arnold was the No. 1 rated legal expert on the AskMe web site. Marcus Arnold was 15. He acquired is legal "knowledge" by watching 'Court TV'. Therein lies the real nature of the Internet revolution."

The New Economy is the Only Economy

Steven Pearlstein, Washington Post, July 2001:

> "Until recently, the 'tech cycle' and the 'business cycle" were largely independent of its other. The tech cycle was so small that its booms and busts did not significantly affect the direction of the overall economy. But in the past decade, the technology sector seems to have an outsized effect, suggesting to some economists that a full-fledged economic rebound will not begin until the technology cycle turns up."

James Paulsen, Well Capital Management:

> "The tech cycle is such a big dog now that if you cannot get that moving, the rest of the economy will likely be very weak. Technology has assumed the importance today that the auto industry had during the 1950s and 60s."

A New Way of Doing Business

Preparing for The Holidays, NYT, Nov. 1999:

> The meeting at Amazon.com ended with the reading of the top 10 terms that bring a customer no result. No. 1 on it is "Pokedex".
>
> "Anyone knows what that is?" Someone replies that it is an electronic organizer listing the attributes of the hundreds of Pokemon characters. An executive is assigned an action item to find a supply as soon as possible. No. 2 is "Pokeman", a misspelling. The site will be reprogrammed to send searchers to the Pokemon page.
>
> There is no easy way for Toys R Us, for example, to keep track of toys its customers cannot find in its stores. But Amazon can log each one and work to get it in stock.

Recent Military History

- Kuwait, 1991: US airpower methodically devastated the Iraqi army. When American tanks finally rumbled into Kuwait, they found nothing much to crush. Dazed Iraqi soldiers were surrendering in droves.

- Kosovo, 1998: Yugo soldiers hunkered in camouflaged bunkers, waiting and hoping for US ground troops. Vengeance would be sweet; lots of bloody ambushes and dogged mountain fighting. The Americans never came, and the bombs kept falling.

- Afghanistan, 2001: American bombs demolished moving tanks, fleeing trucks, and amazed guerrillas. It took only two weeks to chase the Taliban and al Qaeda forces into Pakistan and Iran.

Bruce Sterling, Wired, April 2002: "The world's 4th-largest army–smashed. Battle-hardened Balkan fighters–smashed. The most fearsome mountain bandits on earth–smashed. It's a new strategic reality."

Military Revolution

Facts:

1. *Smarter Bombs*: Precision-guided bombs have gotten more precise and flexible, and more prevalent through the military.

2. *Better targeting information*: The military has improved its intelligence gathering and dissemination capabilities in recent years, reducing from hours to minutes the time it takes to locate targets in the modern battlefield.

Example: The *JDAM*–Joint Direct Attack Munition–is a US$20K kit that transform an unguided ("dumb") bomb into an all-weather satellite-guided weapon.

Pentagon Speak: "denying sanctuary with persistent surveillance and rapid engagement, with high-volume precision air strikes in all times, all weathers, and all terrains."

Historical Perspective

- At the end of WWII it took more than 800 flights by the USAF to destroy a Japanese aircraft engine plant (100% dumb bombs)
- In the Gulf War, it took several flights to destroy similar targets in Iraq (10% smart bombs).
- In the Afghanistan War, an aircraft could hit several targets per mission (100% smart bombs).

Strategic Bombing Can Defeat Armies

Strategic Bombing

- *Old Doctrine*: The objective is to destroy the enemy's will to resist by attacking is "vital centers", cities and infrastructure, and not its battlefield troops. Only success: Hiroshima and Nagasaki.

- *New Doctrine*: Use precision bombing to destroy selective infrastructure and battlefield troops. Successes: Gulf War, Yugoslavia, Afghanistan.

New Role for Ground Troops: target massive airpower.

Daro Khan, Anti-Taliban Commander: "Give me 50 soldiers, and with the help of American bombing I could capture all of Afghanistan in a week".

Von Clausewitz Re-examined

Impediments to Victory:

- *fog of war*: low-quality or nonexistent information
- *friction of war*: inability to hit adversary

US Advantage: "comprehensive situational awareness" and "precision engagement".

Assymetric Warfare

John Carlin, Wired Magazine, May 1997: The future of armed conflict is not smart battlefields, it is networks and information used to defeat uniformed forces.

- Former NSA Director John McConnel: We are more vulnerable than any other nation on earth.
- Former CIA Deputy Director William Studeman: Massive networking makes the US the world most vulnerable target.
- Former US Deputy Attorney General Jaime Gorelick: We will have a cyber equivalent of Pearl Harbor at some point, and we do not want to wait for that wake-up call.

A Chilling Scenario

Georgia's telecom system has gone down.

The signals on Amtrak's New York to Washington line have failed, precipitating a head-on collision.

Air traffic control at LAX has collapsed.

A bomb has exploded at an army base in Texas.

The power's down in four northeastern states,

Denver's water supply has dried up, the US ambassador to Ethiopia has been kidnaped, and terrorists have hijacked an American Airlines 747 en route from Rome.

Meanwhile, in Tehran, the mullahs are stepping up their rhetoric against the "Great Satan"; Iranian tanks are on the move toward Saudi Arabia.

Suddenly, the satellites over North America all go blind ...

Fact: "Information technology is famously a great equalizer, a new hand that can tip the scales of power. And for those on the ramparts of the world's sole superpower, the digital winds are blowing an icy chill through the post-Cold War's triumphant glow."

Anti-US Strategies

- Decapitation
- Radio Frequency Weapons
- Space parasites
- Space sandbagging
- Hacking
- Jamming
- Attack ground stations
- Denial and deception
- Espionage
- Terrorism

New Weapons: RFWs

RFWs: Radio Frequency Weapons. These are devices that generate intense pulses of electromagnetic energy in the radio portion of the spectrum. Narrowly directed energy so generated can be directed over a large distance to a point target, or more widely transmitted to attack a broad target.

- *High Power Microwave (HPM)* devices: Their purpose is to introduce abnormally high levels of RF (Radio Frequency) energy into the target's electronics, thereby destroying or degrading it.

- *Transient Electromagnetic Devices (TEDs)*: Instead of generating a continuous train of energy as a HPM does, it generates a very brief, very high voltage discharge that can momentarily break, and perhaps irreparably damage the functionality of sensitive electronic circuits, memory, CPUs and various semiconductors.

David Schriner, Congressional Testimony, 1998:

> "The net result of all this design, experimentation, fabrication and measurement proves that such a weapon system could be made by anyone with an engineering degree or even a bright technician with good hardware experience. The materials needed are nothing special, and if the effort is made, advanced concepts can be made using everyday hardware such as automotive ignition systems."

The View from The Other Side

Jiefangjun Bao, Chinese Army Newspaper, 1996:

> "After the Gulf War, when everyone was looking forward to eternal peace, a new military revolution emerged. This revolution is essentially a transformation from the mechanized warfare of the industrial age to the information warfare of the information age. Information warfare is a war of decisions and control, a war of knowledge, and a war of intellect. The aim of information warfare will be gradually changed from 'preserving oneself and wiping out the enemy' to 'preserving oneself and controlling the opponent.' Information warfare includes electronic warfare, tactical deception, strategic deterrence, propaganda warfare, psychological warfare, network warfare, and structural sabotage.
>
> Under today's technological conditions, the 'all conquering stratagems' of Sun Tzu more than two millennia ago - 'vanquishing the enemy without fighting' and subduing the enemy by 'soft strike' or 'soft destruction' - could finally be truly realized."

What Technology is Doing to Us?

NYT, Sep. 1997:

> "Technology is changing the world. But what is it doing to us? Propelling us into a new age of affluence or dragging us into a robber-baron era of widening income disparities? Liberating us from stultifying bureaucracies or creating unprecedented opportunities for 'hidden persuaders? Wiring us for success or driving us to distraction? On balance, does technology make us better?"

More Change Is Coming

Paul Saffo, Institute for the Future:

> The change ahead will be later to arrive than we expect. But when it arrives, it will be far more fundamental than we imagine.

John R. Walter, AT&T:

> "It has been said that digital technology eats everything and tramples everyone who tries to oppose it. I believe that understates the case. You do not have to oppose digital technology to be trampled; innocent by-standers will be flattened too. There is no neutrality in the Digital Revolution. You must become a digital revolutionary or risk losing everything."

Stopping Change

"Many people understanding something of what technological progress is doing to us, yet take a passive attitude toward it because they think it is inevitable. But we don't think it is inevitable. We think it can be stopped".

Theodore Kaczynski, Unabomber

It is Unstoppable

Andy Grove, Intel:

> "Whatever can be done, will be done. If not by incumbents, it will be done by emerging players. If not in a regulated industry, it will be done in a new industry born without regulation.
>
> Technological change and its effects are inevitable. Stopping them is not an option!

Managing Change

"Still the question recurs, can we do better? The dogmas of the quiet past are inadequate to the stormy present. The occasion is piled high with difficulty, and we must rise with the occasion. As our case is new, so we must think anew, and act anew."

Abraham Lincoln, October 1862

Re-examining Values

Robert M. Pirsig, Zen and the Art of Motorcycle Maintenance:

> "The most striking example of value rigidity is the old South Indian Monkey Trap. The trap is a coconut shell with a hole in it, baited with food. The monkey reaches in and is suddenly trapped–by nothing more than his own value rigidity. He cannot revalue the food. He cannot see that freedom without food is more valuable than capture with it. If he opens his hand, he's free. But how is he going to discover this fact?"

My Priorities

Daniel Burstein and David Kline:

> We may take some comfort in knowing that however exotic the landscape of tomorrow's world might become, the felt core of human existence – the urge for family, the need for love and belonging, and the desire to live a significant and productive life – will remain as familiar as always.
>
> Our future will not be decided by the high-tech gizmos of tomorrow, but by the flesh-and-blood men and women of today now engaged in an epochal quest whose outcome no one can predict.

Pessimism vs. Optimism

James Burke, Author:

> "Short term I guess I'm a pessimist. I think we are in for some really bad times and I think the end of my lifetime is going to be less idyllic than the beginning was. Because short term, information technology is going to bring change faster than the social institutions can cope with."

Noam Chomsky, MIT:

> "Optimism is a strategy for making a better future. Because unless you believe that the future can be better, it is unlikely you will step up and take responsibility for making it so. If you assume that there is no hope, you guarantee that there is no hope. If you assume that there are opportunities to change things, then there is a chance that you may contribute to making a better world.
>
> *The choice is yours*!"

In Conclusion

Technology is driving the future–the steering is up to us

Yogi Berra:

> "In the years ahead, when you come to the fork in the road, take it.".