

The Challenges of the Digital Age

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I. Introduction

We are in the midst of a global revolution unlike any revolution man has gone through before. We are moving from being an analog society to becoming a digital society the implications of this revolution are breathtaking to say the least and no one understands the complexities of what all this means.

The digital age has broad implications for the Educational and Scientific communities. In education, how will students be educated and trained for a life long quest to learn.

In Science, it impacts how research is conducted, how lab notes are kept and reviewed, how scientists collaborate, how discoveries are published, how therapies are deployed and how the general public receives health care. For really that is what all this is about to increase the longevity and quality of life for our fellow man.

For the consumer it means having access to libraries, information, video content unlike the world has ever seen . and being able to economically communicate with friends, family, and colleagues across time zones.

My purpose today is to frame our discussion in the context of current reality and human need. And thus I will hit upon FOUR Major Points:

- First, A little history of How we got here
- Second, What are the components of this digital age and what are some of the key Social issues facing us;
- Third, I'll discuss emerging technologies which will impact Education, Science and Consumers
- Fourth, The emergence of Electronic Commerce
- And then conclude with some personal observations and thoughts and discuss our challenges

2. A little history of telecommunications development

The invention of writing began some 5000-6000 years ago in Mesopotamia and independently several thousand years later in China. It wasn't until 1500 BC that books began to appear.

Then in 1454, Gutenberg invented the movable type press and published the now famous, Gutenberg Bible which took him five years to organize and print books could now be mass-produced. But still, information could travel no faster than a horse or a man could run.

Then on May 24th, 1844 just 155 years ago Samuel Morse invented the telegraph between the Supreme Court room in Washington, DC and Union Station in Baltimore, MD. We well remember his now famous words that he telegraphed to Baltimore What hath God wrought INDEED

Then in 1876 Alexander Graham Bell invented the telephone In 1895, Marconi invented the wireless in 1920 the first radio station went on the air KDKA Pittsburgh In the 1930s, television was invented and in the 1940s, the first TV station went on the air . Cable television became a business in the mountains of Pennsylvania in 1949. The late 1950 s saw the launch of Sputnik and Echo and satellite communications were born. But not until 1976 did video and satellites come together when HBO and Ted Turner s Atlanta Superstation became the first to use satellites to broadcast to the home via cable television.

But Content was changing too, By the late 1970 s we still had the major news filters of the broadcast networks ABC, NBC, CBS and PBS and the major print outlets. The Washington

Post, New York Times, LA Times, UPI and AP to name a few. If our democracy was truly to be open we needed to take government to the people.

In July 1977, 22 years ago, Brian Lamb and I were at lunch one day in Arlington, Virginia outside of Washington, DC talking about these news filters and how democracy needed to be more open. Out of that lunch came the idea for C-SPAN and in March 1979 20 years ago C-SPAN was launched. The rest is history.

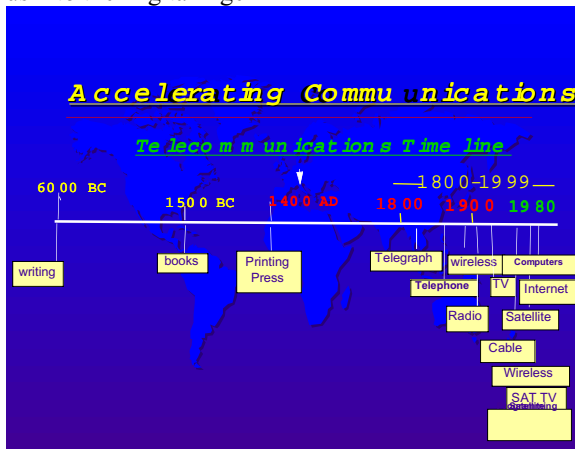
Ted Turner had a similar idea and in 1980 launched Cable News Network 24-hour news. CNN was affectionately known as Chicken Noodle News. The only outlet in Washington area was our Arlington, Virginia Cable system.

Meanwhile, during the 1960s through the 80s the Defense Department, the National Science Foundation, major research universities and defense contractors were developing the Internet. Quietly, researchers were using this network to conduct research, send mail, and store files. In the 80s, services like CompuServe, Prodigy and AOL began to develop.

Computers began to be sold to consumers around 1982. Remember the first Apple? The first IBM PC? Seems like a long time ago.

It was not until 1994 that the World Wide Web was beginning to develop. Remember gopher software you know. Go out on the Net and go for this and go for that. Then came sophisticated Internet Browsers and now we find ourselves in the digital age.

This slide provides an idea of man's accelerating technology to communicate WITH THE LAST 20 YEARS REALLY leading us into the Digital Age.



3. The Digital Age

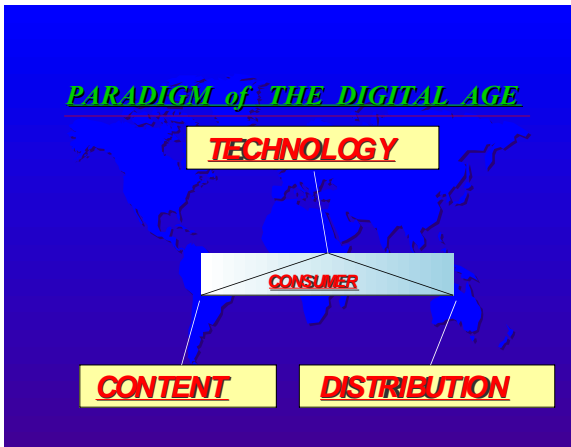
The digital age was spawned by the convergence of high-speed computers, mass data storage, satellite, cable, fiber optic, broadband transmission, new broadcast technologies and packet switching and routing developments. Today, we have:

- Local and Wide area Networks
- Instant e-mail
- Desktop PCs for under \$1000 that have the power of the Big IBM 360s of the 1970s.
- Desktop Video conferencing
- Speech recognition so you can dictate lab notes into the computer and have a written record
- Access to Thousands of Web sites
- Over 100,000 chat rooms where people with common interests interact
- Thousands of news groups that post news and information about thousands of topics from AIDS issues to the latest movie reviews or the uprising in East Timor
- Cable and Satellite systems with over 200 channels of Video programming
- Near Video on demand where you select the program you want to see when you want to see it
- Wireless digital phones with text and messaging.
- And of course the year 2000 bug will all airplanes crash? ATMs lock up? Banks close? Social security checks choke computers? I think not but it is a very serious issue:
 - The estimated worldwide cost to repair is \$ 1 Trillion Dollars
 - Will shrink the US Gross Domestic Product by 3 Tenths of a percent
 - Will add an additional 40% of cost over 3-5 years to fix the Y2K fixes estimated to have a 15% error rate
 - May cause a US Recession

3.1. Digital Age building blocks

Key to understanding this new digital paradigm is to understand that there are three components to it three corner stones three building blocks and if you take nothing else away from my remarks today, take this truth. The digital age is made up of:

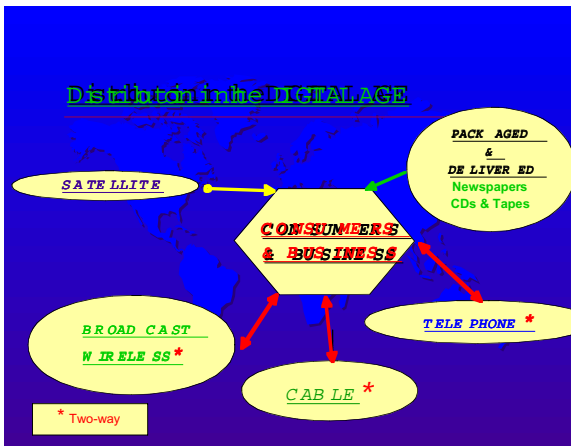
- Technology
- Content and
- Distribution.



I'm going to say those three again
Technology, Content and Distribution.

Further to understanding these building blocks is to look at the five methods of distributing content:

- Satellite distribution;
- Broadcast and Wireless recognizing that broadcast is not two-way interactive but wireless can be;
- Cable Television;
- Telephone; and finally;
- Packaged delivery — like newspapers, magazines, CDs, Videotapes etc.



The first four methods use digital bits. The last, packaged delivery uses atoms though bits may be used to edit material before atoms are applied to paper.

Now overlay content and technology on these distributions models and you can begin to see how complex the digital age is becoming.

Starting in 1997, we saw the three distinctive industries --- industries involved in technology, content and distribution begin to merge Technology companies like Microsoft began

investing in content companies like MSNBC and MSN then invested in distribution companies like the cable company Comcast.

Time Warner began investing more in content and distribution they own Warner Brothers studios, Time, now CNN, TBS, TNT cable network and Headline News Time Warner continues to invest in Cable Television distribution while investing in Road Runner, their new Internet Service Provider Company.

This year, AT&T merged with TCI, the world's largest cable company and struck a deal to buy MediaOne cable in order to rapidly expand its Internet, local loop and long distance business. A \$110 Billion worth of acquisitions for AT&T. AOL a content provider purchases Netscape and leading Software / technology company. AOL Strikes distribution deals with Bell Atlantic, SBC and Direct TV.

Last week Viacom announced a \$35 Billion merger with CBS NBC announced the purchasing of a 32% stake in Paxton Communications to augment its NBC affiliate and cable distribution outlets.

So, when you are reflecting on what the digital age is -- remember its three components: Technology, Content and Distribution

3.2. Social implications

Let me now talk about some of the *social implications* of the Digital Revolution; it has brought about three major social shifts

First, with the rapid development of the digital age starting in 1982, more of the US gross domestic product comes from intangible services than from tangible services estimated in 1998 to be 59.25% of personal consumption Think of it we sell more banking services, more communications services, more information services and other intangible services than automobiles, steel and new homes.

Second, for the first time in man's history, institutions and organizations are becoming more distributed than hierarchical. For example, with 600 million Visa cards issued. There is no CEO of Visa International or MasterCard there is no CEO of the Internet. Those are good examples of a distributed organization.

In hierarchical organizations, those at the top were knowledge keepers and those at the middle and bottom had to go to those knowledge keepers for knowledge and permission. In distributed organizations, the knowledge holders are at all levels and are empowered to make decisions. The question for you is how will your organization, company or institution evolve? In a distributed way or hierarchical way?

Third, we have accelerated discovery on all levels creating an information explosion.

Some of the important issues we'll have to address:

- Training both students and teachers to use the digital tools to accelerate and broaden the education experience;
- Information Haves and Have Nots — Our responsibility to Third World development
- The proper role and responsibility of Media in the Digital Age — As an example: The untimely death of John F. Kennedy, Jr. Was an entire weekend of non stop coverage out of proportion to JFK, Jr's status in our national life that debate will continue
- Integrity & Accuracy of Information Libraries and News Reporting — creating a Good Housekeeping Seal of Approval this is a role for The National Academy of Science, Universities and other institutions we trust.
- A whole host of security issues to protect privacy and digital property rights
- Intellectual Property rights & Copyrights - The World Intellectual Property Organization -- WIPO is one of 16

specialized agencies of the UN and is headquartered in Geneva. The WIPO administers various copyright treaties and represents 167 countries.

- Who pays for access to digital libraries and how much
- What kind of business models will work
- How will we deal with cyber-terrorism like the Melissa Viruses; how will we detect and prevent cyber terrorism what should the legal penalties be
- *And we'll have to address Protocol issues like:* what data traffic has priority. Do video and telephony transmissions have priority over the New York Times download to a subscriber?

These are just a few. To get you thinking

4. Emerging technologies

Having discussed History, some of the aspects and issues of the digital age Let me talk more about Emerging Technologies Exciting Technologies like:

- Super Computer modeling, simulation & data mining
- Video Conferencing to Multi-Point today it is point to point
- Video e-mail
- Voice Recognition for word processing and note taking (DEMO)
- Virtual Reality — I'll talk more about this in a moment
- Video programs on Demand
- Video Streaming (DEMO) of speeches, lectures or events you missed
- Wireless Phone, Text & Messaging by low orbiting Satellites
- Consumer Broadcast Services

Here is a list of currently or soon to be available broadcast — cable video services



And specifically Internet2 and the Next Generation Internet and their implications for the educational, scientific and business communities.

As I mentioned earlier the World Wide Web is only a few years old and the Internet is growing at 15% per month think of it the net is growing at the rate of 15% per month and thus we have net congestion

In 1996, in frustration over net congestion 34 research universities formed a consortium to create the next evolution of the Internet Internet2 was born.

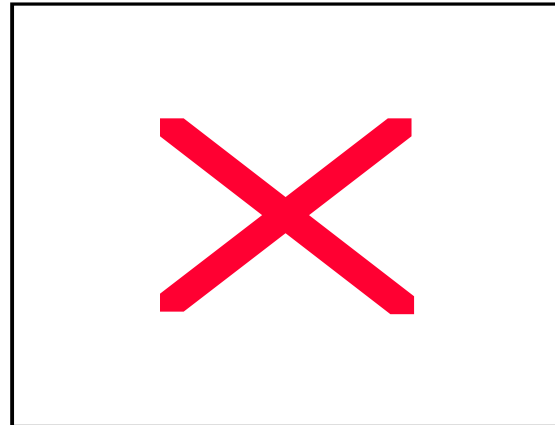
The consortium's official name is the *University Corporation for Advanced Internet Development* (or UCAID) Their Web address is www.ucaid.edu. Today, it includes over 155 research universities and institutions, --- and over 60 corporate members that will create the next generation of the Internet. UCAID's latest effort, the Abilene Project, taps over 17,000 miles of existing fiber optic plant, and with the help of companies like Qwest, CISCO and Nortel, the consortium members will have access to very high speed data lines... Launched last this year, the bandwidth of the Abilene network will be 2.4 gigabits/second. By the end of 1999, the network will support almost 10 gigabits/second or 100 times what it is today. Internet2 members can elect to connect to the Abilene network through approximately 30 GigaPoP Sites.

The goals of Internet2 are to:

- Enable, develop and deploy advanced distribution technology,
- Develop far-reaching applications; and
- Format content for storage, retrieval and digital transmission

In addition to the Internet2 project, two other parts of the Internet growth need to be mentioned:

The US Federal Government's Next Generation Internet initiative (known as NGI) and National Science Foundation's very High Speed Backbone Network Service (vBNS).



The National Science Foundation's very High Speed Backbone Network Service (vBNS) is also recognized as a backbone network service of the Internet- 2 Project and is in the process of upgrading to operate at 2.4 gigabits. The National Science Foundation has a legacy role in high performance networking since the creation of NSF NET initiative from 1989 to 1995. Currently, NSF supports the vBNS as well as the High Performance Connections program with over 100 awards to universities, 36 of which were announced by Vice President Gore last September. (9/18/98)

Even with the new high-speed networks, these applications will need new fundamental technologies hardware and software will be needed to ensure the Internet2 applications will not be affected by network congestion.

5. There are four advanced applications that have broad implications for the academic, scientific and business world

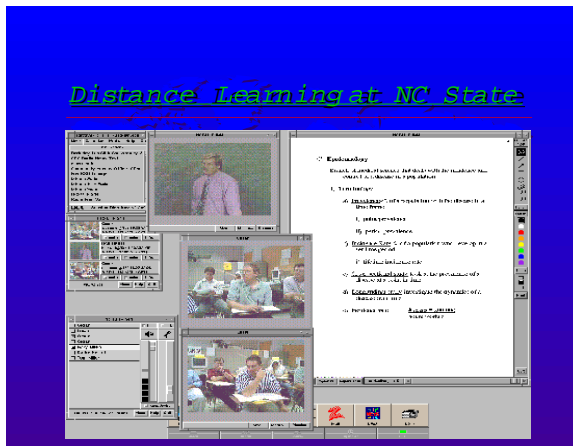
5.1. Accelerated development of digital libraries, high-speed in access and distribution of those libraries

The National Science Foundation, NIH, the Kellogg Foundation, The Library of Congress, and the Mellon Foundation among others are funding this major undertaking. These efforts will take millions of pages of historical

documents, social and scientific research, medical outcomes, and history and make them digitally available to all. A good example is the recent release of the Starr Report, and associated documents on the Internet for worldwide review.

5.2. Distance learning

By way of example, North Carolina State University a part of Internet2 has made great strides in distance learning. As seen here, by manipulating several windows on their computer screens, the UNC-Asheville students can see the professor, his notes, the white board and see the other students in the class. Homework is emailed to the professor before class.



5.3. Teleimmersion

Teleimmersion has the potential to significantly change education, scientific and manufacturing paradigms. A Teleimmersion system will allow individuals at different locations to share a single virtual environment. For example, participants would interact with a virtual group at a conference table approximating what would be possible in a physical room. Individuals could share and manipulate data, simulations and models of molecular, physical or economic constructs, and jointly participate in the simulation, design review and evaluation process. Another example, might be scientists from various locations all participating in using a high intensity electron microscope with a super computer to model the HIV virus as it infects cells. In short, Teleimmersion is creating a virtual reality like the Holodeck on StarTrek.

5.4. Virtual laboratories

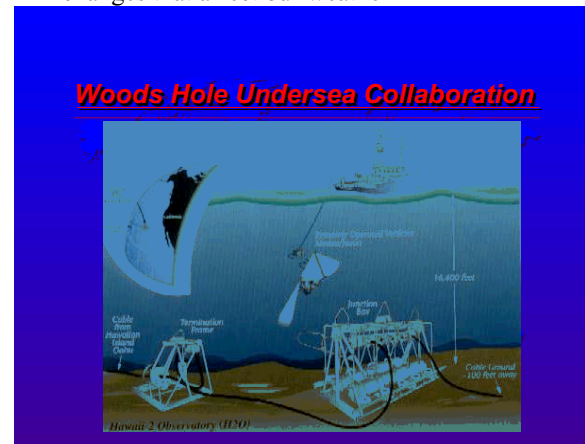
A virtual laboratory is a heterogeneous, distributed problem solving environment that enables a group of researchers located around the world to work together on a common set of projects. As with any other laboratory, the tools and techniques are specific to the domain of the research, but the basic infrastructure requirements are shared across disciplines.

The components of a virtual laboratory include:

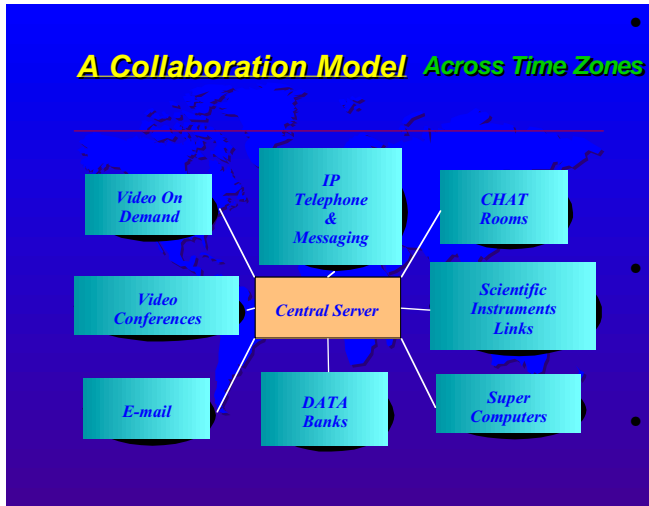
- Computer servers to store data and Lab notes facilitate Video Conferences, Video E-Mail and Text Chat
- Access to Super Computers capable of handling large scale simulations and data mining predict patient outcomes to name but a few;
- Access to Digital Libraries
- Linked Scientific instruments that are connected to the network for example, electron microscopes, spectrum analyzers, and robotic arms to manipulate specimens in a P-3 Safe lab environment as just shown
- Collaborative tools to facilitate data analysis, discovery reduction, and visualization of the experiments.

Here are some examples of long distance collaboration:

- Hurricane supercomputer modeling
- Hurricane analysis like Hurricane Floyd that will menace the East Coast later this week
- Long distance collaboration
- Woods hole oceanography experiment utilizing an underwater digital junction box for a multiplicity of scientific instruments to monitor ocean currents and temperature changes that affect our weather



Here is an example of an electronic collaboration model:



A primary goal of Internet2, NSF and NGI is to turn these visions into reality by ensuring advanced applications and new technologies make their way into the global Internet community --- just as today's Internet is the result of past investment and development by universities and government in cooperative efforts with the private sector.

6. Economic opportunities in the Digital Age

The digital age offers enormous economic opportunities for our entrepreneurs. It is estimated that by 2002 over 328 million people will be connected to the Internet. For now instead of manufacturing and distributing hard goods, the opportunity exists to create, collect, process and distribute information, content and consumer services.

In the US, There are approximately 100 million TV households. 45 million households own a computer online subscribers are 46% of all Computer households Cable-Satellite subscribers are 72% of US households and over 54% watch television while online.

So Economic Opportunities abound .

Opportunities like:

- On-line Shopping: By 2002, online shopping is estimated to be \$37.5 Billion business
- Business to Business E-commerce is expected to be over a TRILLION-dollar business by 2002 Web page authoring and hosting — Creation of Web sites can cost from a few hundred dollars to several \$100

Thousand. The AIDS Site at University of California San Francisco costs over \$400,000 per year to update and maintain.

Portal Advertising: A portal is an entryway to a multiplicity of services with advertising banners on a WEB page that takes you to that company's web site. 15% of all Web traffic is due to portal advertising that accounts for \$870 million in revenue in 1998 and is expected to be \$3.7 billion by 2003.

- Creation of New Network and Information sites. Like the Drudge report. New information networks are created over night. Some very creative business models support these new networks.
- WEB Auction services where excess inventory is posted for quick sale. It doesn't matter where the auction house is located nor where the warehouse that ships the inventory.
- Electronic commerce processing and banking services — Today the catalog shopping business in the US is over \$300 Billion. As much of that shopping migrates to the NET the electronic transactions will need to be banked and accounted for.
- IP Telephony — (within 2 Years)
- Video on Demand — (Within 5 years)

Additionally, there will be new and exciting consumer technologies for example:



- The Electronic Book
- Faster computer processing will speed win out?
- Computer chips to help the visually impaired
- Video cell phones for wireless video conferencing



These are exciting frontiers, which will have broad implications to educators, scientist and consumers and to all of humankind

7. Summary

So, We have looked at a little History explored the Components of the Digital Age Technology Content Distribution looked at social issues facing us Explored some of the Emerging Technologies Some of the Economic Opportunities and what this means to you

7.1. Some personal observations

I want to share with you my personal paradigm and why I am so committed to the development and rapid deployment of telecommunications technology and facilities.

Some years ago when I became President of our company I became responsible for service to 100s of thousands of Customers over 1000 employees and to our stockholders, partners, lenders and the communities we served Well, the book had not been written on solutions to complex problems I was facing I sought a paradigm that would guide me in my decision making For 15 years now that paradigm has guided me well Let me share it with you

If you take all the emotions of life and put them into a crucible, grind them up and boil them all away, only two remain: FEAR & LOVE. All human actions are motivated at their deepest level by one of THESE two emotions — fear or love. In truth, these are the only two emotions — the only two words in the language of the soul. Every thought, every human action is based in either love or fear; all other ideas are but a derivation a form of these two. They

are simply different versions -- different twists — different forms on the same theme.

All healing is accomplished by joining -- NEVER by separation. Whether spiritual healing, emotional healing or physical healing all healing is accomplished by joining the priest with his or her parishioner, the doctor with his or her patient all healing is accomplished by joining.

The purpose in sharing my personal paradigm is to underscore and highlight our challenge to our Educators, our Scientists, our Technologists, our governments, our economists and our corporate leaders the challenge of joining together and using this new and evolving technology wisely.

7.2. What are our challenges?

Our challenge is join together to create a public policy, an educational system and an economic framework to solve our pressing issues in health care, environmental conservation, population sprawl economic growth to name but a few and foster scientific research, deployment of new technology and the creation of new businesses and jobs.

We can only accomplish this by joining together through large scale Collaborations that the Digital Age can foster. Collaborations to:

- Quickly define the role of Government. Government must fashion public policies that embrace the dynamics of the digital age that in turn will ensure the rapid deployment of telecommunications facilities and other technologies Government — Whether Federal, State or Local *must not* create regulatory or public policy impediments to wisely deploying digital technology.
- Define the Human Broadband Information Processing Capacity and its psychological — Social Implications at all level
- Develop Plans to provide the necessary resources to our schools, colleges and universities to thoughtfully utilize digital technology at all levels of education and scientific research;
- Resolve and enforce intellectual property and Copyright issues between countries and our own institutions...
- Develop Programs to Educate and Train Scientists, Teachers, Businessmen, Government officials and the general population to take advantage of the Digital age education becomes paramount;

- Resolve joint grant application and funding conflicts by creating shared resources funding models like the one created for the first NIH funded Virtual Center for AIDS Research (CFAR) between the Universities of Michigan, Wisconsin, Minnesota and Northwestern University
And ...
- Create Economic Models for new businesses with seed and incubation facilities that facilitate technology transfer from the scientific arena to the business world.

These are but a few of our challenges

8. Conclusion

SO Welcome to the Digital Age
Education, Science and our Lives will be forever changed. The digital age is upon us We can either embrace it with love or run from it in fear
Whichever we choose though, the world is evolving in a totally different way than from that of the analog world of just a few short years ago... Our job for the next several days, is to develop a research agenda which help ensure that the digital age benefits and serves all of humankind

Thank you for the opportunity to share my thoughts and hopes with you May God speed us on this great Journey