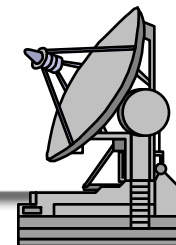




The Future ain't what it used to be: **A look at the 21st century through the eyes of an educator!**

An Information Technology Briefing

by Dr. David Gould





In the race to keep pace with change,
change is winning!

Conference Board of Canada February 2002.



Everything that can be invented has been invented.

- Charles Duell, Commissioner, US Office of Patents, 1899



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- Communication Trends
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Change

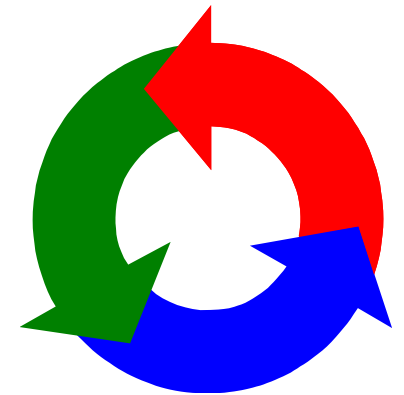
- Key Themes of the Future
 - Fundamental uncertainty
 - Accelerating pace of change
 - Globalization
 - Business
 - Technology
 - Entrepreneurialship
 - Continual need to learn and apply new knowledge





Change

- Total knowledge doubles about every 8 - 10 years.
- The half-life of a Ph.D. knowledge base is about 18 - 24 months, without continual learning.





Change

- Key drivers of change are found in:
 - Remote Environment
 - Economy
 - Technology
 - Demographics
 - Social / Cultural
 - Political / Legal / Government
 - Physical Environment
 - Competitive Environment



Change

- The level of turbulence and its absolute growth rate will be significantly greater in the future than in the past.
- Today's "turbulent times" are not a transition to a new era, a new environment for organizations and their managers.
- To the contrary, **these turbulent times are the new era; they are the long-term future!**

Source: Huber & Glick, 1993



Change

- The exponential growth of technology in the first two decades of the 20th century matched that of the entire 19th
- The exponential growth of technology in the first 5 years of the 21st century will inevitably, inexorably, match that of the entire 20th.
- 2005 Update: The exponential growth of technology in the first 14 years of the 21st century will inevitably, inexorably, match that of the entire 20th.

Source: Ray Kurtzweil, 1999. MIT Inventor of the Year



Change

- Methods for exploring the future
 - Trend analysis
 - Stages of growth
 - Limits to growth archetype
 - Delphi
 - And many others



Change

- Factors of production in classical economics
 - Land, labor, and capital
- The most important factor of production today is **knowledge**





Hardware Trends

- Evolution of Computing Hardware
 - Mainframes
 - Minicomputers
 - Personal Computers / Workstations
 - Networked Computers
 - Mobile / Ubiquitous Computing
 - Multiple form factors, wireless connectivity
 - Grid Computing / on demand?



Hardware Trends

- Continued miniaturization of electronic components
- Decreasing price
- Increasing performance
- Increasing variety of devices
- Increasing storage capabilities
- Increasing display capabilities

Computer processor speed should exceed the speed of the human brain by 2025. Implications include ...



Communication Trends

- Increasing bandwidth
- Increasing use of wireless, even for video
- Improved security
- Convergence of media types – data, voice, video, animation

Global communications infrastructure will support people working or playing together and *in competition*, anywhere, at anytime. Some implications are ...?



Application Trends

- Evolution of IT from 1950 to 2010 +
 - Automation of basic business transactions (finance, accounting, payroll, and so on)
 - Automation of supporting business processes (human resource management, sales force operations, product design, and so on)
 - Cross-activity or function integration (CRM, SCM, and ERP)
 - Integration of value chain and value system (current phase of evolution)
 - Real-time enterprise (automation of activities in the value system will be optimized to work in real time)

Implications of a real-time enterprise might be?



Software / Application Trends

- Recognition – handwriting, voice, pattern
- Collaborative support for virtual teams
- Increasing organizational process automation (electronic business, digital government, distance education, electronic publishing, banking)
- Software agents
- Tags / RFID
- Semantic Web
- Web services
- Security
- Robotics

An increasing amount of knowledge will be expressed in software resulting in significant, but uncertain changes, in how we learn, work, and play. This process will accelerate with these implications



Software / Application Trends

- It's a digital world!
 - Homes
 - Cars
 - Offices
 - Regions
 - Nations

A knowledge economy depends on knowledge workers – people who are educated.

What happens to people when their education stops ...? Slows?

What happens to countries...?





IT Laws

- Moore's Law
 - Processing power doubles every 18 months and the price halves.
- Metcalf's Law
 - The value of a network increases as the square of the number of nodes.
 - The number of bi-directional links = $n(n-1) / 2$
- Reed's Law
 - The number of distinct groups of ≥ 2 in a population of n are $2^{*n} - n - 1$.



Information Rules






1 0 1 1 0 1 1

- Information is anything that can be digitized.
- Information is costly to produce but cheap to reproduce.
- Once the first copy of a digital good has been produced, most costs are sunk and cannot be recovered.
- Multiple copies can be produced at roughly constant per-unit costs.
- There are no natural capacity limits for additional copies

Source: Carl Shapiro and Hal Varian, *Information Rules: A Strategic Guide to the Network Economy*



21st Century Trends

-  E-Business will become a critical competitive strategy that will revolutionize the global economy.
-  Biotech for human enhancement will be the most profitable industry in the 21st century.
-  Artificial life (A-Life) – computer generated entities – will mimic human appearance, language, reasoning, and personality.
-  Human and computer evolution will converge. Synthetic intelligence will greatly enhance the next generation of humans.
-  Computers will become powerful extensions of human beings designed to augment intelligence, learning, communications, and productivity.



21st Century Trends

- 🖥️ NBIC – Nanotechnology, BioTechnology, Information Technology, and Cognitive Science
 - These fields are converging for the betterment of human performance. Source: NSF
- 🖥️ Robotics – a natural outcome of advances in NBIC plus engineering.
 - Next source of low cost labor / productivity

NBIC offers unlimited potential with uncertain risks. What implications do you see going forward?

Robotics is emerging with what implications?



21st Century Trends

❖ Significant Problems

- Climate Change
- Healthcare
- Education
- Political Stability / Conflict
- Economic Security / Poverty / Entitlements
- Pandemics
- Over Population
- Transportation

How can IT help solve some of these problems or can it?



21st Century Trends

- ❖ Business and Personal Processes will be Transformed by increasing levels of
 - Efficiency
 - Self-service
 - Automation / mechanization
 - Outsourcing
- Note: Once a process / job can be scripted, it can easily be made self-service, automated, or outsourced. That is, the job or jobs may well disappear.

How will IT be used to transform processes and with what implications?



Consequences of Accelerating Change

- Decisions must be made more frequently and more rapidly.
- Decision-making will be more complex.
- Decision implementation will be more rapid.
- Information acquisition will be more continuous.
- Information acquisition will be more wide-ranging.
- Organizational learning will be more managed.

Source: Huber & Glick, 1993



Knowledge is the key to the 21st Century,
and **education** is the means to acquire it.



Preparing for the Future

- Denial is neither a river in Egypt, nor is it an option – decisions must be grounded in reality
 - Use fact-based hypothesis-driven problem solving methods
- Apply strategic planning concepts
 - Document your mission statement, values / ethics and live by them
 - Scan the external environment and develop an early warning system
 - Assess your skills, resources, and capabilities
 - Determine your strengths, weaknesses, opportunities, and threats
 - Make the best strategic decisions you can
- Keep what works, change or delete what doesn't. Recycle this process
- Continue to learn – an undergraduate degree is essential, an advanced degree provides an edge
- Productivity is a function of technology (use the best available), process (continue to improve your work processes and outsource and automate what you can to free up time and money for other investments), and the capability of doing work (improve your skills, learn new ones – key skills include subject matter knowledge, collaboration and teamwork, oral and written communications, research, and critical thinking)
- Apply double loop learning to improve your effectiveness – efficiency is good, but only takes you so far
- 10% of success is competence; 30% is image; and 60% is visibility – work up the "stack"
- Network, network, network – build relationships to succeed

Adapted from Peter Schwartz, Pearce and
Robinson, Joel Barker, Chris Argyris and others



Preparing for the Future

The world has **changed**.

The new business environment needs fewer people **trained** to do things repetitively in a specific way, and demands more people who are **educated** to find new ways of doing things.

Source: Adapted from Dr. Thomas. I. Sheppard



Preparing for the Future

Thinking

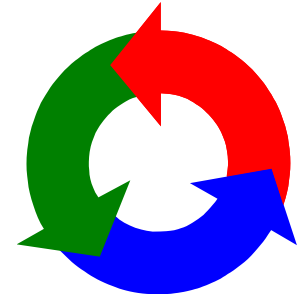
Learn to think **abstractly** and apply knowledge in new and different ways.

Practice **critical thinking** and **systems thinking** for effective problem solving.



***We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time.***

-T.S. Eliot





Implications

What **implications** do you see for yourselves and your organizations as change accelerates and technology enables new challenges, opportunities, and threats?





Welcome to the 21st Century!