

Web Conference

STFPP Research Report # 7

SCIENCE AND TECHNOLOGY FORESIGHT
PILOT PROJECT



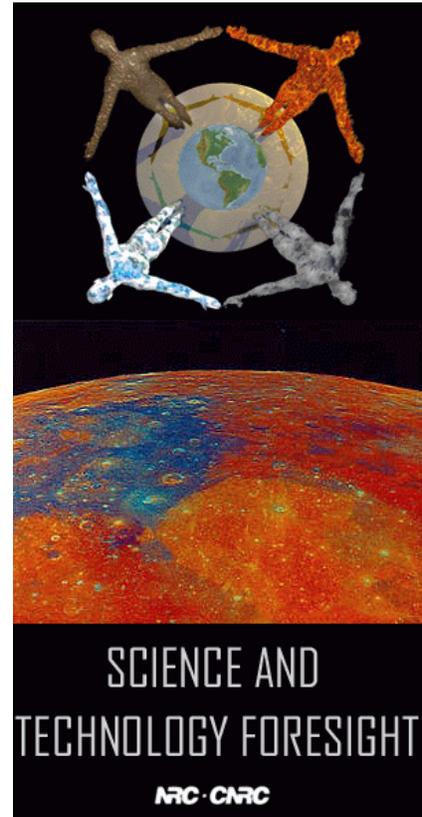
A Research Report of the Science and Technology Foresight Pilot Project:
A Partnership of Federal S&T Organizations

Web Conference

An Experiment in Structured Brainstorming

*(Process and Outcomes of the STFPP Web
Conference held February 3-10, 2003)*

Edited by
Moya Mason, Hassan Masum



Science & Technology Foresight Pilot Project Research Report

June 2003

Science and Technology Foresight Pilot Project Web Conference

In early February, the STFPP team organized a Web conference, whose edited contributions are captured in this document. The purpose of the conference was to gather opinions and foster discussion on Foresight topics, from a select group of international contributors. A complementary purpose was to explore the use of guided Web conferencing as a tool for future Foresight work - one that (due to its low cost, global reach, and asynchronous nature) might offer advantages worthy of making it a standard tool in the foresight portfolio.

The following invitation was sent out to prospective attendees by Jack Smith, Project Leader:

On behalf of the Canadian Science and Technology Foresight Pilot Project (STFPP) team, I am pleased to invite you to join in a four day web-hosted workshop that seeks to elaborate and develop the initial findings from a series of workshops and technical panels that were held in the fall of 2002. Many of you attended one or more of these panels and workshops and we are grateful for the ideas and knowledge you provided.

The purpose of the February 3-10 online workshop is to enable all the participants, as well as a selected group of additional experts and generalists who were not able to be involved in the fall events, to consider the findings that we have had summarized into two reports and to help us develop the information further in preparation for the scenarios work to be done by the project team in March 2003. The workshop is deemed to be a critical element of the iteration of observations and results from the fall events of 2002.

A description of the context and staging of the pilot Project is included in the background documents that will be posted at the Conference site, including the mandate of STFPP, which is to explore the long term future of technology as it relates to the scientific activities of science based departments and agencies (SBDA) in the Canadian federal government.

I hope you are able to join us online for this next stage of the Project.

This experimental Web conference was implemented using a brainstorming platform arranged via Howard Rheingold's web site. Given the depth and diversity of some of the contributions - and the relative ease of use, cost effectiveness, and potential for bringing in contributors who might otherwise not participate due to geographical or time limitations - it may be worthwhile to consider use of the Web conference platform as a potential tool in future Foresight activities.

Foreword

This research report is part of a series of several reports that have been produced for the benefit of sponsors, participants and professionals interested in how emerging and prospective developments in global science and technology might impact Canada's future.

The Science and Technology Foresight Pilot Project originated with a proposal made by NRC to the community of federal Science Based Departments and Agencies in March 2002, offering NRC's support for a collaborative pilot project to explore the application of foresight tools. Goals of the pilot project were to help stimulate longer term thinking, and to build shared R&D awareness and capacity for engaging broad challenges for which the federal S&T community should be better prepared.

Thirteen federal Departments and Agencies joined together to create a limited duration (i.e. six months) partnership that sponsored 20 events and at least 30 meetings. The partners and their colleague networks of scientists and industry-academic collaborators contributed over 400 days of professional time to developing the Project's methodology, panel and workshop events and in drafting and reviewing the Science and Technology Foresight Pilot Project findings.

It is useful to recall the definition of S&T Foresight that was used to define the scope and focus for this Pilot Project:

S&T Foresight involves systematic attempts to look into the longer-term future of science and technology, and their potential impacts on society, with a view to identifying the emerging change factors, and the source areas of scientific research and technological development likely to influence change and yield the greatest economic, environmental and social benefits during the next 10-25 years.

S&T Foresight is necessarily speculative, creative and analytical simultaneously because it must rely both on the interpretation of S&T change drivers and on how and when these could become significant factors in Canada's prospective social, economic, and political realities. Since these are highly uncertain, foresight is inherently about attempting to understand, dimension and reduce or at least prepare for significant risks.

The following statement has been used to caution foresight participants and stakeholders not to take these reports as fact or prediction. They represent collaborative research that was conducted primarily for learning purposes, with the understanding that if a strong consensus emerged regarding possible application of insights to an actual funding program, then these domains might eventually warrant inclusion in one or more future S&T funding initiatives.

*The approach we are taking relies upon consulting a wide range of expertise, with the expectation that through our collective experience, imaginative abilities and interactive knowledge of technological development pathways, we can begin to construct a coherent view of **some of the major developments that can be anticipated within a 10-25 year time horizon.** Foresight is therefore research which can inform the reality of planning, policy and strategic choice amidst uncertainty. This is the nature of foresight - creating a range of plausible future elements that in their diversity should alert readers to the kinds of issues and perspectives they may not have initially considered in longer term research planning and contingency thinking. **Accordingly, this report reflects the combined views of the participants, and the best wisdom and creative thinking that we could stimulate with the tools of foresight,** but it clearly does not represent an official view of the Government of Canada or any of its Departments and or Agencies.*

*Jack Smith
Leader, Science and Technology Foresight Pilot Project
May 2003*

NRC Foresight Workshop

[Moya K. Mason \(moya\)](#), Organizer

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)



Welcome to the National Research Council of Canada's [Science and Technology Foresight Pilot Project](#) Workshop Web Conference. The purpose of this virtual event is to enable participants to consider the findings that we have summarized into the Geostrategics and Biosystemics reports, and to help us develop the information further in preparation for the Scenarios Workshop to be held in March 2003 (and subsequent work to be done by the project team).

This Web Conference is now closed, and took place in early February 2003.

# Title	Last	Last Active
1 Sign In	53	09-FEB-2003
2 Help Desk	0	29-JAN-2003
3 Introduction	5	08-FEB-2003
4 Geostrategics: Principal Findings	53	11-FEB-2003
5 Transformative and Disruptive Technologies	83	11-FEB-2003
6 Message from your Host	16	11-FEB-2003
7 BioSystemics: Introduction of Principal Observations	12	06-FEB-2003
8 BioSystemics: Biotechnology Observations	35	07-FEB-2003
9 BioSystemics: Nanotechnology Observations	21	07-FEB-2003
10 BioSystemics: Information and Cognitive Technology Observations	39	06-FEB-2003
11 BioSystemics: Systemic Technologies Observations	3	06-FEB-2003
12 Convergence, Socio-Economic Impacts and Policy Implications	39	10-FEB-2003
13 Brainstorm Session One: Fuel Cells	30	10-FEB-2003
14 Brainstorm Session Two: Biosensors	16	10-FEB-2003
15 What's Your Take?	15	11-FEB-2003
16 Wildcard: Mainland China	11	11-FEB-2003

NRC Foresight Workshop

[Moya K. Mason \(moya\)](#), Organizer

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Nrc Technology Foresight Workshop Item 1

[Home](#)

Items: [1](#) [2](#) [3](#) [4](#) [5](#) [6](#) [7](#) [8](#) [9](#) [10](#) [11](#) [12](#) [13](#) [14](#) [15](#) [16](#)

Sign In

Item 1 29-JAN-2003 12:08 Moya K. Mason

I am a freelance researcher and have worked with Jack Smith off and on since 1999. I am your host for this event and welcome you to what I hope will be a very exciting and stimulating conversation. Enjoy yourselves!

1:1) 03-FEB-2003 00:14 Louis Atkinson

Hi! I am a multi-disciplinary visual artist and web programmer/designer. I work with Moya and am helping to host the workshop. I would also like to welcome you to this event.

1:2) 03-FEB-2003 10:16 Richard Smith

Thanks, Moya and Louis. Just signed in and am looking forward to exploring the topics you've brought together here.

1:3) 03-FEB-2003 10:18 Bob Watson

Good morning. I'm a librarian with a professional interest in the ecology of information and the limitations of knowledge. I am a generalist by nature and a specialist by necessity -- I'm hoping to help weave a general consensus.

Hi, Moya! Hi, Louis! Hi, Richard!

1:4) 03-FEB-2003 10:38 Moya K. Mason

It is great to see you two! I am really excited by the prospect that our voices can actually help to shape the future of Science and Technology in Canada.

1:5) 03-FEB-2003 11:18 Howard Rheingold

Hello, I'm a writer, speaker, thinker-about-the-future, and instigator of virtual communities. Click on the picture below to find out more than you need to know about me.



1:6) 03-FEB-2003 12:41 John Verdon

Hello, I'm a strategic HR analyst with the Department of National Defence. I to am a generalist and therefore interested in everything. Both the BioSystemics (ah the post-human, post-species ecology) and the GeoStrategics are of high interest to me and relevant to my work interest. I am excited about this event and participating in these discussions.

1:7) 03-FEB-2003 12:43 Moya K. Mason

Hi, Howard!

Thanks for letting us have this space for the conference. Howard is the owner of this large virtual community called Brainstorms.

As we mentioned in our initial email to everyone, we are giving away copies of Howard's new book: [*Smart Mobs: The Next Social Revolution*](#) to six participants to be chosen on the last day of the conference. I was lucky enough to have worked on this book as researcher.



1:8) 03-FEB-2003 12:46 Moya K. Mason

Hi, John! I am really glad you could make the time to join the conference. I think it's going to be great.

1:9) 03-FEB-2003 12:51 Daniel Cormier

I am a surveillance officer with the Surveillance and Risk Assessment section of Health Canada--in short, epidemiological matters are of interest. I have a background in theoretical/computational chemistry.

1:10) 03-FEB-2003 12:58 Charles Cameron

Hello, all. I'm happy to be here.

I spent a couple of years recently studying the social impact of high-surprise wildcards as Senior Analyst with The Arlington Institute, and many of the issues and concerns raised in the two NRCC reports are eerily reminiscent of that work. My own interests draw me in two directions here: the design of conceptual mapping tools that allow for a qualitative understanding of complicated problems, and the unexpected impact of intense religious and quasi-religious worldviews on the kinds of issues we're discussing here.

I look forward to our interactions in this conference.

1:11) 03-FEB-2003 13:32 Nicholas Carroll

Hello, I am an information architect with [Hastings Research](#), and a Research Associate with the [Stanford Archimedes Project](#). By lack of definition, an information architect is a generalist who can somehow pummel computer systems into submission, inventing new ways of doing things as they go. My background is primarily programming, systems integration, interface design, and information structure/retrieval, along with a smattering of geology, physics, work physiology, and neurology.

I grew up in Canada and Europe, moving to America in my teens, and courtesy of that confusion, I observe both America and Canada with the curiosity of a cultural anthropologist.

1:12) 03-FEB-2003 13:34 Louis Atkinson

Hi Daniel, Charles and Nicholas.

Glad you all could make it. I'm sure you have lots of experience that will add depth to the conversations.

1:13) 03-FEB-2003 14:06 David Crabtree

Hello, Presently, I am on secondment from the Canadian Space Agency to the Defence R&D Canada specifically to work on the S&T Foresight Pilot Projects as a member of the project team. Both Agencies are interested in Foresight methodology development and in the outcome of the two pilots. My recent background is in project and program management within the International Space Station Program and on Space Technologies at CSA.

1:14) 03-FEB-2003 14:18 Burl Grey

Hello all.

I'm excited to be here on your screen.

My area of interest is systems epistemology and 'what it means to be human'.

I've been a member of 'The American Society for Cybernetics' for decades.

If I can make any meaningful contribution to this conference I'll be thrilled.

1:15) 03-FEB-2003 14:22 Raymond Bouchard

Hello.
Raymond Bouchard signing in. I am the knowledge manager for the BioSystemics theme of the TFPP. This has generated a lot of interest. I had the opportunity of presenting this morning to a planning session of Health Canada.
Nice to see we are giving away Howard's book as a prize. I just finished reading it and recommend it highly. So if you don't win it, buy it. Then read it.

1:16) 03-FEB-2003 14:54 Moya K. Mason

It's great to see you here, David and Burl. Can't wait to hear what you have to say.

Although we have structured the day into two subject areas, everyone should feel free to focus on any part of the Geostrategics report they want to. There are no hard and fast rules here. We want to hear everything you have on your mind.

And hi to Raymond. Raymond is the author of the Biosystemics Report that we'll be looking at tomorrow, and was invaluable as part of the team who put this conference together. Many thanks to you.

1:17) 03-FEB-2003 15:11 Donald Melanson

Hello everybody,

I'm the founder and editor-in-chief of [Mindjack](#), an online magazine about the intersection of technology and society (among other things). I also work as a freelance writer and designer.

I currently reside in Fredericton, New Brunswick, where I'm a student at the University of New Brunswick. For more information about me, you can read my weblog: [melanson.ca](#).

1:18) 03-FEB-2003 15:13 Ole Peter Galaasen

Hi there, I live and work in Oslo, Norway. I run the Plausible Futures Newsletter and the "This Week in Nanotech" newsletter from NanoApex. I like writing about nano- and biotechnology and it's consequences for society in general.

1:19) 03-FEB-2003 15:23 Jim W. Lai

I'm a software developer by profession and a generalist/synthesist by inclination, with a formal background in computer science and physics. My current position is with Program in eHealth Innovation.

<http://www.uhnres.utoronto.ca/ehealth/>

1:20) 03-FEB-2003 15:59 Louis Atkinson

Welcome, Donald, Ole and Jim!

1:21) 03-FEB-2003 16:32 Bryan Alexander

Greetings! I'm at the [Center for Educational Technology](#), and work on [computer-mediated learning](#) and digital culture.

1:22) 03-FEB-2003 19:27 Dirk Flinthart

G'day. I write as Dirk Flinthart. I appear online under that same name simply because that's the way I really got started on the Web some seven or eight years back. Mostly I'm a writer, preferably of fiction, and most often of speculative fiction -- but I have a background in science, and an ongoing affiliation with education. I expect that by and large my role here will be to apply creative and tangential thought processes to the material brought to light.

1:23) 03-FEB-2003 20:08 Ingar Moen

Hi, I am Director of S&T Policy with Defence R&D Canada with responsibilities for Technology Watch, Potentially Disruptive Technologies etc. We are having an ongoing discussion on disruptive technologies and I look forward to hearing how the Technology Foresight activity can contribute to this discussion. I note that there are several potentially disruptive concepts that have emerged from the Foresight activity to date.

1:24) 03-FEB-2003 23:19 Robert F. Johnston

Hi, I am Robert Johnston. I am a computer software generalist. My father built the first computer in Canada and I was a cofounder of one of the first computer software companies in Canada: I. P. Sharp Associates. I have lived in Canada all my life but spent time in other parts of the world including Europe, Korea, Japan and South America as well as the USA.

I am interested in Computer intelligence, epistemology and most recently Stephen Wolfram's "New Kind of Science" which I think will change the way we think about future developments on the planet as well as in Canada.

1:25) 03-FEB-2003 23:27 Andrew Plumb

Greetings and thanks for the invite, Moya.

I've been an Applications Engineer with [Cadence Design Systems \(Canada\) Ltd.](#) here in Ottawa for the past three years, supporting those of our customers doing analog/mixed-signal IC design. Before that I spent a year and a half at [Chipworks](#), and I began my professional career at the [Canadian Microelectronics Corporation](#), in Kingston, ON.

Looking forward to the discussions here! Unfortunately, I have to go down to Champaign, IL later this week to visit a couple of customers, but I've been assured the hotel has high-speed net access.

1:26) 04-FEB-2003 06:38 Moya K. Mason

I would like to welcome all the new arrivals and wish them a week filled with interesting commentary. Thank you all very much for coming!

1:27) 04-FEB-2003 12:14 Jack Smith

Hello to all of you who have joined us for this initial web conference on the NRC S&T foresight pilot project. My name is Jack Smith and I have been asking myself for months the kinds of questions we are posing in the Conference. They may not be the best questions but at least they introduce us to the contingencies of the future with a focus on how these broad areas of capability - geo and bio are beginning to stretch our concepts of disciplines, domains and fields. So I welcome all of your thoughts about these emergent forces and insights and how they may shape our understanding of what are often weak signalled alignments of future significance.

1:28) 04-FEB-2003 12:22 Jack Smith

That was - stretch our concepts - so a key objective of this Conference is to examine the imaginative possibilities that these two rather broad and even artificially labelled topics stimulate us to develop. The most intriguing area that we have not begun to explore in much depth is the premise that cognitive science developments could enable the brain and the computer to be quite readily linked in activity as well as in design - that we may be able to actually connect thinking patterns and neural design to processing of information needs that demand abilities that our normal consciousness rarely or almost never permits - a sort of update on what John Lilly once called the programming and meta programming of the human biocomputer. So if anyone has some ideas for how this domain might have evolved by 2020 please suggest possibilities.

1:29) 04-FEB-2003 12:33 Howard Rheingold

I am slightly skeptical about this because of nothing more than a sense of hubris: Our knowledge of how to construct microelectronic components is vast, but our knowledge about how the nervous system actually operates is considerably less vast. It's easier to experiment with circuits than brains. I don't think it pays to assume too quickly that the state of knowledge about neural functions will advance as rapidly as knowledge of IT.

1:30) 04-FEB-2003 13:11 Burl Grey

I agree that strong skepticism is necessary because the rate and kinds of changes *without* cyborgs are already too fast and deep to understand, much less manage.

People like [Warwick](#) are certainly moving fast with his cyborgs.

And way back in 1996 Prof. Radermacher at the U of Ulm, proposed [this](#):

My emphasis.

" The paper proposes a four-level architecture for the cognitive apparatus of future autonomous systems, addresses the handling of nested time scales, tries a first step towards **a technical approximation of consciousness** as a linear abstract control channel within a massively parallel architecture..."

I believe we have to focus on deeper, more immediate and subtle ideas about the kinds of assumptions we share and how to engage each other without overload.

I quote a single idea from Lawrence Lessig's "The future of Ideas" page 5

"A time is marked not so much by ideas that are argued about as by ideas that are taken for granted."

1:31) 04-FEB-2003 13:37 Louis Atkinson

I have copied the three previous posts to [Item 10](#), BioSystemics: Information and Cognitive Technology Observations

1:32) 04-FEB-2003 13:37 Nicholas Carroll

DELETED (will repost in Item 10).

1:33) 04-FEB-2003 14:08 Adam L. Gruen

Greetings! Dr. Adam L. Gruen here, checking in.

Historian of technology by trade (Duke University, 1989). Student and protege of Dr. Alex Roland. Former historian of the International Space Station Programme, former historian at WorldCom, current technology writer for the Missile Defense Agency. Futurist and author of the wacky novel [vCity 1.0](#) (1994).

To learn more about me, click on my name above and you'll see a picture of me smiling (a rarity) and hoisting a stout (not a rarity).

1:34) 04-FEB-2003 15:05 Geoffrey Gurd

Greetings everyone. An impressive list of characters so far ;)

My background is in communication (PhD), but not the technical aspects although I have studied telehealth applications and their impacts on organizational communication.

Currently I am with Health Canada managing a division that coordinates, funds and communicates policy research.

1:35) 04-FEB-2003 15:25 Moya K. Mason

Hi, Adam and Geoffrey! Yes, definitely a great cast of characters and credentials.

Isn't it wonderful that although we are geographically sprawled around the world, in this place, we are together?

1:36) 04-FEB-2003 23:21 Robert Crosby

Greetings all. I am Robert Crosby. I live in Eagle River, Alaska, where I work as an ecological engineer -- having migrated to that from a background in mechanical engineering and energy management. I share with Burl (and a number of others here) a deep interest in systems dynamics and epistemology. [These interests](#) find their natural expression in projects such as [these](#).

Apologies for coming to the party late. Just returned from traveling.

[edited to add: Thanks for the invite, Moya! Looks fun.]

1:37) 05-FEB-2003 05:46 David Brake

Hello, all - I am an ex-pat Canadian who has been living in London for the last 16 years. I have been writing about technology for most of that time as a computer and then an Internet journalist as well as working with industry. Just to complete the circle, I have recently entered academia as an MSc student at the LSE. A number of my friends in Canada are career scientists in academia. Or I should say a number of my friends now working in the US are career scientists?

1:38) 05-FEB-2003 08:09 Moya K. Mason

Hi, Robert and David! So glad you could take the time to drop in. Thank you.

Please feel free to jump in.

1:39) 05-FEB-2003 14:12 Ahmed Shalabi

Greetings, I am an Engineer with a hashed background in Material Sciences, Metallurgy, Nuclear Design, Quality/Life-Cycle Management, and Process(Systems) Design. I am currently working for the Department of National Defence with the responsibility of improving Acquisition, Capability to Grave, for the Canadian Forces. This on-line workshop is a great form to target the right people, at the right time, for defining future performance trends, and even re-define past and present performances, for Technology Implementation.

1:40) 05-FEB-2003 14:48 Bruce Damer

I am a co-director of a nonprofit (Contact Consortium www.ccon.org) and a member/founder of The Digital Space Commons (www.digitalspace.com). Interests: virtual worlds, communities, the disappearing commons and vanishing democratic systems, advanced technology in energy production, space technology, and collecting vintage computers. Apologies for coming late, just got back from Death Valley with my honey.

Our lives on the farm here (with the pigs) are described at:

<http://www.damer.com>

and hey.. i am a canuck too!

1:41) 05-FEB-2003 15:22 Nicholas Carroll

Speaking for Moya -- who is probably getting her 2 hours of daily sleep -- welcome aboard, Ahmed and Bruce. Please dive in fearlessly; you'll note that you can edit your posts after the fact, a very reassuring feature of Brainstorms software!

1:42) 05-FEB-2003 20:19 Moya K. Mason

Thanks, Nicholas. Hi to our new arrivals!

1:43) 06-FEB-2003 10:26 Scott Mackenzie

Hi, I'm Scott MacKenzie. I work at Consulting and Audit Canada. My primary work is in the areas of Information Security, R&D, Disruptive Technology and Innovation. I think that trying to get a better handle on the Disruptive process may have substantial long-term benefits.

1:44) 06-FEB-2003 11:11 Moya K. Mason

Hi, Scott. Glad you could make it!

1:45) 06-FEB-2003 12:10 Peter Kallai

Hi everyone,

I am Peter Kallai, the knowledge manager for the Geostrategics theme of the TFPP. I am signing in a bit late as I was out of the country and just getting back. It appears that the Geostrategics findings have generated a lot of interest. I agree with some of the comments that the report is optimistic. Our methodology focused on the things that "could happen". We expect that the scenarios, however, will bring a number of other perspectives that may slow down or accelerate certain technology developments. Right now what we have is blue sky thinking of the potential.

1:46) 06-FEB-2003 12:29 Louis Atkinson

Hi, Peter. We're happy to see you here.

1:47) 06-FEB-2003 12:44 Moya K. Mason

Hi, Peter!

1:48) 06-FEB-2003 19:31 Tom Malis

Hi all. I'm Tom Malis, a Scientist Advisor with Natural Resources Canada, and one of the participants in the Biosystemics Nanotech Panel. I am also happy with the extension as I have just finished an extended visit with Mr. Flu! I've followed nanotech for roughly 20 years and it is one very interesting subject/concept/impending tidal wave of change. More to come on that once my head finally clears. Nice mix of people here but where are the scientists? Are they all that shy?!

1:49) 06-FEB-2003 20:03 Moya K. Mason

Great to see you here, Tom! Enjoy yourself.

1:50) 06-FEB-2003 21:14 Phil Staal

Hi! I'm Phil Staal, a scientist from DND -- I think I just caught Tom's flu... I'm also having a hard time adjusting to the tenor of the workshop -- I'm used to more of a technological thread into the future, and I've just returned from a workshop with a group of various officers from police/border agencies who need technology to help them with problems next week or next month -- my time scale needs drastic readjustment...

I'll be back...

1:51) 06-FEB-2003 21:24 Moya K. Mason

Hi, Phil, a technological thread is good and would be most welcome. I encourage you to choose any tenor you feel comfortable with.

1:52) 09-FEB-2003 11:10 William Pugsley

Being a natural contrarian, and having posted comments during the week would like to introduce myself - better late than never!

- meteorologist with a 34 year career in the fed govt (Transport, Environment, National Defence)and 3 years on national executive of Canadian Meteorological and Oceanographic Society (President 1998-99)

- currently active in futures oriented organizations: [Canadian Association for Club of Rome](#) (Vice Chair 2001/02), [International Council for Computer Communications](#) (Governor 1999-2005), member of steering committee for *Futures and Strategies Network* and *Canada @21* - two Ottawa futures groups (with Jack Smith and Raymond Bouchard)

Have enjoyed participating in this virtual conference

Thanks to Moya and Jack especially

Bill

1:53) 09-FEB-2003 11:59 Moya K. Mason

So glad you could make the time to join us here. Let's hope we get to do it again soon! It really is a great way to have a conference. Thanks, Bill.

Nrc Technology Foresight Workshop Item 1

[Home](#)

Items: [1](#) | [2](#) | [3](#) | [4](#) | [5](#) | [6](#) | [7](#) | [8](#) | [9](#) | [10](#) | [11](#) | [12](#) | [13](#) | [14](#) | [15](#) | [16](#)

Nrc Technology Foresight Workshop Item 2

[Home](#)

Items: [1](#)|[2](#)|[3](#)|[4](#)|[5](#)|[6](#)|[7](#)|[8](#)|[9](#)|[10](#)|[11](#)|[12](#)|[13](#)|[14](#)|[15](#)|[16](#)

Help Desk

Item 2 29-JAN-2003 12:10 Moya K. Mason



By clicking on the **green question mark** Help at the top and bottom right of every page you can access Help Files. You can also ask any questions you may have right here or email [me](#).

Nrc Technology Foresight Workshop Item 2

[Home](#)

Items: [1](#)|[2](#)|[3](#)|[4](#)|[5](#)|[6](#)|[7](#)|[8](#)|[9](#)|[10](#)|[11](#)|[12](#)|[13](#)|[14](#)|[15](#)|[16](#)

Nrc Technology Foresight Workshop Item 3

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Introduction

Item 3 29-JAN-2003 12:10 Moya K. Mason

The principal purpose of the Conference is to obtain commentary and feedback on the contents of the two synthesis reports (the [Geostrategics Report](#) and the [BioSystemics Report](#)) of the Science and Technology Foresight Pilot Project topics that NRC has developed after the series of workshops and technical panels that were held in the fall of 2002. We seek to elaborate and develop the initial findings from the reports. The workshop is deemed to be a critical element of the iteration of observations and results from the fall events of 2002.

Many of you attended one or more of these panels and workshops and we are grateful for the ideas and knowledge you provided. We welcome your additional comments and insights, as well as those from a selected group of additional experts and generalists who were not able to be involved in the fall events but who are with us here at this Internet forum.

We welcome you to this experimental endeavour as we try to imagine what kinds of technologies and societal contexts for 2015-2020 might be shaped by the types of prospective developments envisioned in the two reports.

All of you are invited to take a look and see whether these reports stimulate your creative side or trigger thoughts that would add richness and robustness to them. During March 2003 these reports, plus the commentary you make here will be used to develop plausible scenarios that could represent future situations or challenges for the Canadian federal R&D community and NRC.

Each day we will pose distinct questions related to both the topics and reports.

3:1) 03-FEB-2003 12:57 Moya K. Mason

A little more information on the structure of the conference might prove helpful.

Our Timetable:

Day 1 - Commentary on GeoStrategics

Day 2 - Commentary on BioSystemics

Day 3 - Integrative possibilities between the two themes

Day 4 - Implications for innovation, S&T policies and programs

The conference site is open 24 hours a day, so you can come at your leisure.

3:2) 05-FEB-2003 10:15 Jack Smith

Hello and welcome to those of you that are newly joining/arriving today the third day of four for this Conference. Please select an area and try to at least register one comment- we will be reviewing each and all comments to see what can be added to our bio and geo synthesis overviews. We also will be adding these comments into the general binning of ideas for how we approach the scenarios we are developing. If resources permit, we may also hold a second web Conference focused on the scenarios we develop before they are finalized for our final report which is due in early April. So far there are many very insightful and applicable points that these discussions are generating - Thanks to all of you who have contributed - and also to those of you who are so far just viewers, please throw us a few ideas as well.

3:3) 07-FEB-2003 19:45 Jack Smith

For those of you who are just now checking out the Conference, or returning for a quick view- we have decided to extend it to enable/encourage more of the total contact group to venture a posting. I realize that the format and purpose may be new to many of us, but that is obviously also part of the discovery/learning plan here, so please add your thoughts. In particular we are seeking some reference points through feedback on just how conservative, naive or adventuresome you believe we have been in attempting to ascertain what might be some of the driver technologies for 2020 that are within the imagination of the present - or for that matter outside the present paradigms and therefore in the realm of what we call wild cards. But then who in 1980 could have imagined the connectedness and immediacy of the internet, or even in 1999, who could have imagined that the value of some prominent telecom company shares would drop below \$ 2 when they were moving from the steady values of \$ 20-30 toward \$ 100 and beyond - so one must also ask when making assumptions about the future- what if it is also the opposite - can the unthinkable be thought of too?

Nrc Technology Foresight Workshop Item 3

[Home](#)

Items: [1](#)|[2](#)|[3](#)|[4](#)|[5](#)|[6](#)|[7](#)|[8](#)|[9](#)|[10](#)|[11](#)|[12](#)|[13](#)|[14](#)|[15](#)|[16](#)

Nrc Technology Foresight Workshop Item 4

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Geostrategics: Principal Findings

Item 4 01-FEB-2003 22:25 Moya K. Mason

Geostrategics is defined as "The future horizons and applications of geo-spatial data and related knowledge management technologies for decision support, including pattern recognition software, wireless communications infrastructure futures, and links to major new capacities in surveillance, ecological monitoring and resource management technologies."

The Geostratgic project attempts to answer the following key question as defined in the terms of reference:

"How will geo-strategic knowledge, technology and prospective applications likely to be available in 2025 reshape our understanding of Canada, its land, sea and air/space resources, and provide new capabilities for national security, and the stewardship and sustainability of Canada's resources?"

What do you think of the Principal Findings? Comments? Criticisms? What would you add?

Principal Findings

Ubiquitous Peer-to-Peer Sensor Webs

It is highly anticipated that by 2025 we will have a myriad of interconnected sensors monitoring various aspects of our world, including the environment, people and moving targets. Continuous monitoring of water resources, air quality, and disease threats will be widespread with the use of inexpensive, integrated, intelligent sensors. These sensors will be able to perform a variety of analytical tasks, including biological, genetic, chemical tests etc., by using highly integrated 'biochips'. Analyses that takes place today in labs will be done "in-situ", with all analytical and processing algorithms integrated within the sensors. It is expected that real time transmission of results will take place after validation of the results against peer sensors in events where key thresholds are surpassed. When monitoring people, security agencies will be able to identify and track the movement of individual suspects, similar to tracking the spread of invasive species, through matching against biometric databases.

Real-time Data, Information and Knowledge

There is increasing pressure to receive real-time data and information for a variety of critical public sector applications and decisions. As an example, national security applications such as border monitoring and, in emergency situations, real-time remotely-sensed data, is of very significant value for decision-makers. Current remote sensing systems (e.g. satellites and sensors) are unable to meet this demand. With the introduction of new micro and even nano satellites, should these become cost-effective, such limitations could be overcome by 2025. Inter-satellite communications, using advanced photonics technologies for data transmission, will enable the continuous coverage and receipt of data by the users, almost like we receive radio signals, in the form of an always-on "geo-utility".

Wireless Internet

Wireless communication is expected to maintain its growth momentum for the next two decades. Wireless will be the preferred choice for the implementation for Ubiquitous Peer-to-Peer Sensor Webs, including a strong micro-satellite constellation in space and expanded land-based wireless infrastructure. Much of the text, voice, data and image communication is expected to go through the next generation of the Internet. People or sensors will be equipped by universal software-defined radios, which will be able to communicate in any form (voice, image, text) with any peer and infrastructure around it, by simply uploading the right communication protocols and through multi-functional intelligent antennas. The high increase in wireless communication will require high capacity space and land based communications backbones, which will be supported by the next generation of nanophotonic communication devices and components.

New Geo-Location Based Services

A whole new array of location-based services is expected to be in place within the next two decades. These new services will be based on the combination of providing the geolocation of something or someone and a status in one or more variables. For example, we expect to wear wireless health monitors by 2025, which will be connected to a central monitoring station and receive various health readings, such as vital signs. This specific service would be very important for high-risk patient populations, such as people with heart disease. Other examples include the geo-location and tracking of offenders after their release on parole, or tracking unmanned vehicles transporting goods.

Integrated, Shared Geostrategic Infrastructure

Ubiquitous Peer-to-Peer Sensor Webs will have to be built on or around massive infrastructures, considering the size of Canada and the wide variety of desired data, but these infrastructures could be shared among the various departments interested in implementing such webs. As an example, schools or other government-owned buildings in urban areas may be equipped with integrated sensors to track air quality and microorganisms that cause disease. Measurements can be processed at the sensor level and results may be sent to databases integrated with climate (historical) and weather forecasts (future) to allow for the storing, analysis and accurate prediction of air quality and potential disease threats. The same integrated infrastructure could be utilized by health and the environment agencies and departments to maximize benefits to Canada. Another use for this infrastructure might be the monitoring of water, air and fish indicators in the environment.

Intelligent Knowledge Systems for Common Good Applications

It is expected that future generations will be much more reliant on technology to make operational and policy decisions. The future lies in the development of systems that are capable of synthesizing data and information into knowledge, in a way that effectively supports decisions. Such systems could also become autonomous learning systems, once they produce new knowledge through analysis of decisions and decision impacts. The highest form of these systems will be allowed to make simple decisions, without major human intervention or interaction and command, and to communicate and control robots that can implement such decisions. One can imagine a host applications for such systems in the area of national security, such as the sensing and elimination of attacking missiles, vehicles, etc.

Virtual Reality Worlds

In order for technologies and scientific knowledge to be accepted by Canadians, scientists must communicate and popularize their discoveries. By 2025, we may expect the wide proliferation of virtual reality and interactive tools used to create complex models – for example models of local, regional environment – that will allow people to interact with these models and see the impact of certain decisions. Current virtual reality-based, interactive games could provide the base capability and technologies. Such virtual reality worlds could be of use to communities sharing interest in certain decisions. Examples for such virtual reality worlds could include the modeling of oceans, environment, urban transport, national security, spread of invasive species, etc., just to name a few.

Increased Complexity of Knowledge and Decision-Making

Our desire to make the best possible decisions prompt us to explore many interactions that are present in complex natural systems, such as the oceans and/or the environment. As an example, in order to make the best possible decisions about coastal zone areas, one must explore over 20 interdependent factors, such as land use, economic activity on shore, the fishery, climate, weather, vegetation, salination, coastal erosion, etc. This creates tremendous complexity in decision analysis and decision making. In ideal conditions, scientists would collect all required data on all factors and interdependencies to create a complex model to simulate decision(s) and decision impacts. The conditions are, however, rarely ideal. Decisions must be made in a timely fashion, without complete data sets or information. In such cases, we could take advantage of decision-support technologies such as soft computing, or chaos and complexity theories.

Convergence and Complexity of Systems

Many of the Geostrategic applications identified above will require the convergence of various technologies and science areas. This will add a very significant complexity at the systems level. As an example, the creation of Ubiquitous Peer-to-Peer Sensor Webs with integrated, intelligent sensors could require the convergence of such scientific knowledge and technologies as genomics to identify species, where these genomic tests would be “burnt into” integrated circuits designed for advanced plastic materials, instead of silicon, which in turn is being manufactured through nanotechnologies to allow for large scale integration and miniaturization.

Once the sensors are put in place, information will be shared and validated in a peer-to-peer environment, which will require that the sensor not just collect, but perform data processing functions. Information is in turn transmitted through high bandwidth wireless infrastructure, using terrestrial or space infrastructure and stored in multiple interconnected databases; this will allow seamless data integration based on international data standards and allow for real-time analysis.

4:1) 03-FEB-2003 11:24 Howard Rheingold

Here is one to add: [ad-hoc supercomputer communities](#):

4:2) 03-FEB-2003 12:56 Bob Watson

I would want to know who is in a position to evaluate the findings/results of these specialized technologies. The outputs will be there to satisfy designed goals, but who will evaluate w/o looking through the lens of a given specialty?

These technologies have (or will have) multiple uses now unknown or underappreciated. Oversight and action responsibilities need to be planned into the mix.

Added knowledge does not necessarily make decision making easier, IMO anyway.

4:3) 03-FEB-2003 15:06 Nicholas Carroll

A good question. America is the most specialisation-mad country I've lived in, and the results of that were manifest in the dot-bomb, for it was not merely greed that led to the dot-bomb, but the folly of placing narrowly educated technologists in charge of companies addressing the broad tapestry of ecommerce. (The last-ditch attempt to save dot-bombs by bringing in narrowly educated financial types certainly did not help matters.)

In that light, I was amused by this excerpt from page 6 of the BioSystemics.pdf: "Indeed ... the U.S. is well ahead in its understanding of the implications of the new technologies. They understand that technological superiority is the key to continued U.S. preeminence, and security, and all that it brings."

Speaking from the brawling, turbulent madhouse south of the 49th, I would rather say that Americans do not so much "understand" that technological superiority is the key to these things, as simply have an unshakable faith in technology as a solution, period. That, coupled with American ambition, assures a continued output of innovation for good or ill.

This puts Canada in the advantageous position of being able to:

A. Focus a greater percentage of its scientific brainpower on analysing what the future brings, and what to do about it.

B. "Cherry-picking" the most promising American innovations.

C. Then focus Canadian energies on areas of research that more specifically target Canadian opportunities and threats.

=====
Now, if I may be excused for a few hours, it seems Moya has assigned me 120 pages of reading!

4:4) 03-FEB-2003 16:02 William Pugsley

Picking up on what Nicholas was saying (lack of foresight south of the border but claiming Canada has it) and relating this to Geostrategics (the theme workshop I attended in the fall)

- I beg to differ but mainly because I think we have the thinkers and funders of S&T at the wrong level of government to tackle the most urgent piece of business - and, that is, the needs of cities and urban areas- which are in order of priority:

- a) transportation and transit - how to make it more efficient and less polluting
- b) human health issues in addition to those caused by a)
- c) better buildings to live and work in

- I know having been a federal public servant myself (in the weather and climate area) that it is easy to think that the federal government's mandate covers everything worth worrying about but increasingly I see issues from the city viewpoint not being met in terms of what kind of science is being done or planned

- we need (and don't have) pollution free cars (not Ballard cell technology which needs hydrocarbon energy to charge). This means a lot more development of renewable energy sources and perhaps fusion. Yet not much has been done since the 1980s Energy Program- has it?

- we need (and don't have) real time measurement and reporting of pollutants dangerous to human health in and around cities and roads. This means identifying which pollutants are most dangerous and then finding cheap and effective ways of measuring them. Thanks to the smog prog (fed/prov beginning in June 2000) and the LRTAP program a number of "oxides" are being measured but what about the very small particulate matter (e.g. PM2.5) and what about reporting it (only one station reports daily in Ottawa)

Just some thoughts
Bill

4:5) 03-FEB-2003 17:41 Nicholas Carroll

Hello William. I'm not sure I would say that Canada *has* the foresight that I feel the U.S. lacks, but that it ought to*. Too much of the world waits to "see what the Americans do," a trait I've noticed as far away as Australia. Yet with the more limited human capital of 26(?) million people, Canada must necessarily identify which needs are uniquely Canadian.

E.g., a nighttime satellite photo of North America shows Canada's deadly vulnerability to any continental cooling trend, what with that narrow band of lights visible along the lower 150 kilometers of the country -- and unlike Americans, Canadians cannot pack up and move to Arizona (unless they plan to pose as migrating geese). These are the kinds of problems that Americans have no urgent need to solve. It's definitely a "roll your own Canadian solution" issue.

* In which light I find the mere existence of this project quite heartening.

4:6) 03-FEB-2003 19:48 Dirk Flinthart

I'm intrigued by the very positive interpretation laid over most of what I have seen on the reports. Simple example: page 14 of geostrat, they lay out the basic assumption that Moore's Law will continue to hold good for the next twenty-three years, leading to a 16000-fold increase in computing power by 2025.

Last I heard, we're reaching the limits of silicon in terms of what we can do with semiconductors. I realize there have been excursions into other media, and that for the moment, Moore's Law is good -- but one of the assumptions they're making to support their belief in Moore's Law is a considerably greater ability to control and direct nanotechnology.

That may in itself not be possible. At the nanolevel, Things Are Not Always What They Seem. Two examples: some of the earliest work in buckyballs (carbon-60 spheroids, I believe) was directed at using the little critters to make a kind of "superlubricant" based on their microspherical shape. It was theorized that a 'paste' of buckyballs should provide an amazing lubricant that would work even in space.

It didn't. They just don't roll around like little marbles, you see.

Then there's this: <http://www.commondreams.org/views03/0131-01.htm>

A small discovery concerning the second law of thermodynamics at the nanolevel. It seems that the law in question isn't entirely reliable under those circumstances. Which makes things... kinda difficult.

I've just picked two examples from the earliest part of the geostrat report, but they jibe with what I've read in the biosys report too. Both of these reports appear to me very optimistic in their underlying science -- and possibly even naively optimistic in the sense of what world economics and politics will permit.

4:7) 03-FEB-2003 20:11 Dirk Flinthart

...and I had to laugh at the p19 expectation of a "self-healing ecosystem" by 2025-2050. Why? Well, that would be because ecosystems are pretty much by and large "self-healing" as a matter of evolutionary course. That is: any stable eco-system has within it processes which help to maintain that stability, so long as certain parameters remain within specific limits. Examples of such parameters include ambient radiation (including temperature), supply of water, supply of nutrients, etc.

In general, the more complex an ecosystem is, the older and more stable it actually is -- contrary to intuitive considerations. In actual fact, simple ecosystems are much easier to disrupt and destroy, because they contain fewer stabilising (self-healing) processes. However, we have amply demonstrated over the last five hundred years that any ecosystem can be destabilized by pushing the necessary parameters outside certain limits. When that occurs, the ecosystem breaks down -- but most importantly, another one develops in its place.

For example: the forests of Ireland, denuded by Cromwell amongst others, have given way to meadowland patchworks, and in places such as the Burren, to complex grassland ecologies of their own. This is one of the major evolutionary processes of the world, according to current models of evolutionary development.

Therefore: the idea of human technology creating a "self-healing ecosystem" is either 1) redundant, as ecosystems already have this capacity, or (which may be worse) 2) destructive to the process of evolutionary development of life.

4:8) 03-FEB-2003 21:16 Dirk Flinthart

However, the very positiveness of the reports is valuable in that they represent an exploration of hopes, based on what would seem feasible processes of technological advancement. Umm -- are there any other speculative fiction writers in this forum? If there are not, then I think I'm going to have a field day playing "what if"? with these things!

4:9) 03-FEB-2003 22:08 Jim W. Lai

Another wildcard. Nuclear explosions in space disrupt the Van Allen belts and effectively deny access to satellites, shutting down space superiority.

http://www.globalsecurity.org/space/library/news/1995/at_950504.htm

Doomsday Scenario

Aviation Week and Space Technology, 1 May 1995, p. 21

Rogue nations with only a few nuclear weapons could choose to attack their larger, better armed foes indirectly, according to Air Force Maj. Gen. Kenneth Hagemann, director of the Defense Nuclear Agency. He claims a 50-kiloton nuclear weapon exploded 62 mi. above the Earth would "pump up the Van Allen radiation belt[s]" to the extent that increased exposure would cause satellites to "die in hours, days or weeks. The effects could last for months." Hagemann warns that the loss of satellites could wreak havoc, for example, with the ever more important information highway and with the world banking system. He also points out that satellites are becoming more vulnerable to various kinds of radiation. As electronics are miniaturized, they require less power and thus are susceptible to smaller disruptions, according to the DNA boss. And as satellites stay aloft longer, radiation effects on them accumulate.

4:10) 03-FEB-2003 22:14 Jim W. Lai

The yield might have to be higher than that. "Hannegan(sic)" appears to be merely extrapolating material and claiming it to be true.

<http://www.thebulletin.org/issues/2001/ma01/ma01auer.html>

[edited to add] Nevertheless, EMP weapons could endanger satellites and meshes.

4:11) 03-FEB-2003 22:48 Nicholas Carroll

As a friend in charge of a sector of the U.S. satellite control system told me, "Satellites have more uptime than they have a right to." This was the man in charge of getting the likes of C5 back online from his control center on Earth.

A senior official at the U.S. Federal Reserve Board once told me, "If the system goes down for a day, we can recover. If it goes down for two days, we think we can recover. Three days? We don't know."

With the increasing reliability of most machinery, the art of redundancy is being forgotten. An unfortunate bit of memory loss, when one starts treating systems-critical machinery with the same casualness as a car.

I, for one, favour a future in which the daredevils take the chances, and some more sober groups attend to the basic issue of survival.

4:12) 04-FEB-2003 06:45 William Pugsley

Having just reread the Jan 03 geostrategics report, and recognizing the shuttle tragedy over the weekend, I don't think we should leave the geostrategic topic or the link to S&T in the USA without mentioning manned space flight and what this could involve and imply for Canadian space science and technology.

I heard Marc Garneau, President of the **Canadian Space Agency**, suggest 2 months ago at an event on Parliament Hill that having a man on Mars - perhaps even a Canadian man (or woman) - within 20 years was possible and feasible once a faster transportation system was invented to shorten the round trip travel time from many months to weeks or even days. Some Americans (see lead editorial from today's **New York Times** clipped below) and perhaps some Canadians feel that manned space travel is a waste of time and resources. However, others point out that overcoming the challenges of manned space travel has advantages that are hard to duplicate with robotics - and if the goal is higher and more difficult to achieve - something like Mars in 20 years - then other rewards in terms of associated gains in allied fields are likely - in this case, a breakthrough in transportation and new ways of protecting humans and their health in a hostile environment.

I'd like to see this mentioned in a geostrategics context because the applications from the space program seem obvious. I know there are participants from CSA and MDA in this workshop - perhaps they might wish to add or comment on more specific aspects.

Cheers
Bill

[A Failed Mission](#)

By PAUL KRUGMAN

Some commentators have suggested that the Columbia disaster is more than a setback — that it marks the end of the whole space shuttle program. Let's hope they're right.

I say this with regret. Like millions of other Americans, I dream of a day when humanity expands beyond Earth, and I'm still a sucker for well-told space travel stories — I was furious when Fox canceled "Firefly." I also understand that many people feel we shouldn't retreat in the face of adversity. But the shuttle program didn't suddenly go wrong last weekend; in terms of its original mission, it was a failure from the get-go. Indeed, manned space flight in general has turned out to be a bust. The key word here is "manned." Space flight has been a huge boon to mankind. It has advanced the cause of science: for example, cosmology, and with it our understanding of basic physics, has made huge strides through space-based observation. Space flight has also done a lot to improve life here on Earth, as space-based systems help us track storms, communicate with one another, even find out where we are. This column traveled 45,000 miles on its way to The New York Times: I access the Internet via satellite.

Yet almost all the payoff from space travel, scientific and practical, has come from unmanned vehicles and satellites. Yes, astronauts fitted the Hubble telescope with new eyeglasses; but that aside, we have basically sent people into space to show that we can. In the 1960's, manned space travel was an extension of the cold war. After the Soviet Union dropped out of the space race, we stopped visiting the moon. But why do we still send people into orbit?

In space, you see, people are a nuisance. They're heavy; they need to breathe; trickiest of all, as we have so tragically learned, they need to get back to Earth. One result is that manned space travel is extremely expensive. The space shuttle was supposed to bring those costs down, by making the vehicles reusable — hence the deliberately unglamorous name, suggesting a utilitarian bus that takes astronauts back and forth. But the shuttle never delivered significant cost savings — nor could it really have been expected to. Manned space travel will remain prohibitively expensive until there is a breakthrough in propulsion — until chemical rockets are replaced with something better.

And even then, will there be any reason to send people, rather than our ever more sophisticated machines, into space? I had an epiphany a few months ago while reading George Dyson's "Project Orion," which tells the true story of America's efforts to build a nuclear-powered spacecraft. The project was eventually canceled, in part because the proposed propulsion system — a series of small nuclear explosions — would have run afoul of the test-ban treaty. But if the project had proceeded, manned spacecraft might have visited much of the solar system by now.

Faced with the thought that manned space travel — the real thing, not the show NASA puts on to keep the public entertained — could already have happened if history had played out a bit differently, I was forced to confront my youthful dreams of space flight with the question, So what? I found myself trying to think of wonderful things people might have done in space these past 30 years — and came up blank. Scientific observation? Machines can do that. Mining the asteroids? A dubious idea — but even if it makes sense, machines can do that too. (A parallel: Remember all

those predictions of undersea cities? Sure enough, we now extract lots of valuable resources from the ocean floor — but nobody wants to live there, or even visit in person.)

The sad truth is that for many years NASA has struggled to invent reasons to put people into space — sort of the way the Bush administration struggles to invent reasons to . . . but let's not get into that today. It's an open secret that the only real purpose of the International Space Station is to give us a reason to keep flying space shuttles.

Does that mean people should never again go into space? Of course not. Technology marches on: someday we will have a cost-effective way to get people into orbit and back again. At that point it will be worth rethinking the uses of space. I'm not giving up on the dream of space colonization. But our current approach — using hugely expensive rockets to launch a handful of people into space, where they have nothing much to do — is a dead end.

4:13) 04-FEB-2003 09:36 Bob Watson

Let's not forget the issue of ongoing costs in a (naturally) politicized environment. It's one thing to fund development and deployment (as with the space shuttle) but quite another to maintain funding over a longish period of time given other -- often politically necessary -- demands.

From that POV, tech is a real pain. The long-term political costs may well be higher than the short-term buzz of immediate popularity.

4:14) 04-FEB-2003 10:45 Randy Gillespie

Hi. Perhaps I am a bit out of phase with the proposed structure for the conference. My apologies. I took the opportunity to read the GeoStrategics report last night and would like to offer a comment or two. In my opinion, Peter has done an adequate job of synthesizing the results of the workshop sessions (at least the one that I was able to participate in). There is a lot of very good stuff to chew on. My primary concern is that you/we have not yet engaged 'big business' in this exercise. As such, we are getting a very 'supply side' perspective on things.

4:15) 04-FEB-2003 13:07 Nicholas Carroll

"My primary concern is that you/we have not yet engaged 'big business' in this exercise. As such, we are getting a very 'supply side' perspective on things."

"Marketing" is normally my mantra, much to the boredom of people interested in vision stuff. If you'll carry that flag, Randy, I heartily encourage you!

4:16) 04-FEB-2003 13:25 Nicholas Carroll

To Bill's comments:

"I'd like to see this mentioned in a geostrategics context because the applications from the space program seem obvious."

The space program, IMO, has potential value far beyond R&D, for a couple of reasons that are unlikely to occur in our lifetimes, if ever:

1. Earth might become uninhabitable, for reasons that have nothing to do with our own folly. Barring a **very** disruptive development in physics, we are unlikely to all be jetting off for Alpha Centauri anytime soon. However in the general interest of humanity, it would be nice to keep progressing towards that capability.

2. Alien invasion is a ludicrous scenario. It is also impossible to calculate the probability based on our current knowledge.

Far-fetched, I'm sure, but the scenarios are almost unique in character -- because like individual death (whether from disease or aging) -- they are at present utterly beyond our control. This sets them apart from issues like terrorism or famine, which are human-generated problems, and can be cured by political as well as technological means.

4:17) 04-FEB-2003 17:04 Jack Chambers

I was involved in a Geostrategics Workshop, and Peter has done a good job of summarizing those discussions. The Workshops were, as intended, futuristic and blue sky in nature. On the other hand, there are the and sometimes nearer term concerns and issues raised by departments and agencies in the initial phase of this project (the some 39 proposals). The challenge to the scenario setters will be to relate these two aspects in a way that will be meaningful to decision makers, and serve as a point of departure for future work.

4:18) 04-FEB-2003 17:48 Jack Smith

These reports reflect a wide range of contributions and the authors have tried to be somewhat value neutral about the prospects envisaged as possible or plausible - so I would like to throw into consideration the tendency of scenario writers, despite the apparently positive flavour of the two reports, to be more inclined to posit problem scenarios that may be encountered as our civilization attempts to imagine a future lifestyle and S&T dependence different from the present than to indicate the benefits of new infrastructures and technological bases for humans trying to adjust, manage or respond to evolutionary forces. Should we the project team seek a general balance between positive or optimistic scenarios and negative problem ridden and pessimistic ones? How would you given your experience and viewpoints approach this challenge?

4:19) 04-FEB-2003 17:50 Bob Watson

In my opinion, "balance" gives a false notion of the problem. An array of views may be necessary.

4:20) 04-FEB-2003 18:38 Dirk Flinthart

Wearing my sf writer's hat: I'll toss in a consideration which seems to have been missed by the Geostrat group -- room temperature superconducting materials.

Currently, I believe the upper limit for superconducting is 164K. To date, all high-temperature superconductors include layers of copper and oxygen, usually alongside elements with exciting names like Yttrium or Reallyweirdium. There are a number of theories as to how this phenomenon comes about, but no real concensus as yet. (Something like ten thousand papers per annum worldwide on high-temp superconductivity over the last few years.)

However: recent research in carbon nanotube tech indicates that there may be superconductive properties along such tubules. As yet, the superconductivity is not fully established, and is believed not to pass the joins in the nanotubules... but since nanotech is such a basic assumption across the board in both the biosys and the geostrat report, it seems reasonable to consider this particular possibility: that nanotechnology will permit the assembly of room-temperature superconductors, possibly even at a mass-production price.

Even if mass production was not possible, the advent of temperature-robust superconductors would certainly create an entirely new revolution in electronics. And if mass production was possible, then the revolution would extend to electrics -- transmission of energy, storage, usage, etc.

4:21) 04-FEB-2003 19:24 Nicholas Carroll

"An array of views may be necessary."

Always.

If you ask me -- and I'll flatter myself that Jack did -- I'll answer this way: The problem is that Americans aren't daring enough, and Canadians aren't cautious enough.

Have I lost my mind? No. I'm saying that to survive, moreso to thrive and succeed in projects, I don't think you can be too optimistic or pessimistic. One has to take both to the max. It's not a quality vs quantity type question. One needs both, because when the 101st contingency occurs, the person who has mapped out 100 contingencies will be the closest to the solution -- not the person who mapped out 10 contingencies.

4:22) 05-FEB-2003 05:59 David Brake

Coming to this session a little late, alas...

Wearing my newly-acquired social scientist hat, are disciplines like sociology covered under the umbrella of SBDAs? I only ask because a number of the technologies outlined here may call for not just scientific input but (for want of a better word) social scientific input. I am particularly thinking of the kinds of privacy-invasive technologies that are envisaged in the report.

If we assume that they are on their way, should we not be deploying some sociologists to attempt to understand their likely social impacts now, to help policy-makers and the media/general public to grapple with the balance of cost and benefit of such technologies and with possible regulatory issues?

Similarly, some R & D spend could go into creating "public good" technologies that would, for example, help the public to understand and manage the amount of public data being created by and about them. This is an area that industry left to itself may not be too helpful with...

4:23) 05-FEB-2003 08:09 Dirk Flinthart

Broadly, I'd like to add to David's ideas. Speaking as a sometime teacher and online educator, I know well that one of the greatest problems facing us lies in the fact that the enablers and manipulators of the most powerful new technologies are an elite few.

Even the Internet, which is hailed as the most egalitarian and levelling of technological developments is nothing of the sort. Although most of us are now capable of assembling a basic web page, how many of us could maintain an Apache server? More to the point: how many of us are in actual fact involved in ICANN, or any of the other organizations charged with shaping, directing and controlling the Internet?

The sheer volume of new toys and goods being turned out serves to mask the fact that most people are nothing more than passive consumers -- that real understanding of the power of new technologies, and exploration of the potential of those technologies, is limited to a very privileged few. More than any other issue, I should like to see some kind of move towards levelling the field. I know well that not everyone is going to be a cutting-edge researcher -- but when the only voice that most of us have with regard to the directions of new technology lies in goddam *market research*, then clearly, we're doing nothing less than deliberately creating a new theocracy.

4:24) 05-FEB-2003 09:39 Jack Smith

The contrast between Canadian and American approaches suggested in the commentary is an interesting one in that it speaks to heritage, training, cultural, national motivations & myths and competitive differences that many have observed in how our two composite identities have in the past contributed to and are today shaping the domains we are addressing in the Conference. In **Geostrategies**, the primary Canadian origins were for resource monitoring and mapping, whereas the US driver was defence and surveillance; in **BioSystemics**, the Canadian driver appears to be a more viable and dynamic public health system, whereas the US driver is likely new biotechnological patents and wealth creating applications - many of which will have public health applications, but many will only be accepted slowly because of undetermined cost-effectiveness outcomes. As the Canadian economy has gradually become more closely integrated with that of the US it will be instructive to watch how these factors which currently differentiate may begin to shift.

□ **4:25) 05-FEB-2003 11:52 David Crabtree**

A conflict between opposing interests in development of IT and RT (robotic technology) defines three plausible scenarios: - "Techno-mania", "Techno-ethics" and "Techni-ban". The battle lines were redrawn in 2000 with the release of 2 books in paperback edition and of a magazine article: -

1. *ROBOT: mere machine to transcendent mind*, Hans Moravec, Oxford University Press, (Paperback - May 2000).
2. *The Age of Spiritual Machines: When Computers Exceed Human Intelligence*, Ray Kurzweil (Paperback - January 2000)
3. *Why the future doesn't need us*, Bill Joy, Wired Magazine, Issue 8.04, April 2000

The 2 books describe the emergence of robots possessing greater intelligence than humans by about 2050. Joy's estimate is 2030. They all envision future RT development fueled by ever more rapid advancements in IT. Humans pass laws decreeing that developers can create only robots that are "nice", but then what happens when the design task is intensively automated and finally when human designers are made redundant? It will then be robots that design and build ever more powerful and capable robots. In effect, humans will no longer be in control. While Moravec and Kurtzweil predict that the human race is facing the prospect of extinction in the foreseeable future, it is a relatively benign form thereof.

Bioengineering will provide an increasing range of artificial organs to replace failed ones. Soon, we would become cyborgs and then later transform completely into machines. Bill Joy recons differently; in transforming, he doubts we would retain our humanity. Ever the technocrat and never the firebrand revolutionary, Bill Joy may be embarrassed that his article is widely referred to as the "Joy manifesto". In fact, he makes a well reasoned argument for caution, not banning technological advancement altogether. Without constraints, he sees the Kurtzweil and Moravec scenarios, as our fate; and worse, the world will end up as either "grey goo" because of run-away nanotechnology, or "green goo" as a result of run-away biothechnology. At the further extreme are those who would ban technological development completely. The Taliban regime in Afganistan was fundamentally opposed to "modernism", and even tried to ban the use of some existing technologies.

Technomania is the state in which "almost anything goes". Unconstrained technology development is legally permitted as it is in most technical disciplines and many jurisdictions now. Commercial profit is the driving force, no matter that a new technology may create new problems that then require the development of additional remedial technologies. On the demand side, clients indulge themselves in ever increasing expediency, regardless of the the environment.

Techniban is the state in which its proponents fear more than the job loss the Luddites feared. They fear extinction and ban any form of technical development. If they could, they would also ban the use of existing technologies. The term is reminiscent of the Taliban who channeled their religious zeal into a campaign against modernism.

Techno-ethics is the state in which society controls the advancement and application of technology so that it serves only the public good. New technologies have to be approved before they are applied. A case could be made for having a techno-ethics organization possessing great authority or influence within a given jurisdiction. Such an organization would possess high level competencies in S&T foresight, environmental and social impact assessment, and ethics. Even in the absence of a commercial sector to benefit from technological entrepreneurship, a techno-ethics organization would be able to advise government decision makers or help citizens protect themselves against undesirable side-effects of technological innovation.

4:26) 05-FEB-2003 12:38 Louis Atkinson

A far-fetched idea for an electrical enery source: a space elevator at the North Pole that works as a Faraday dynamo.

4:27) 05-FEB-2003 14:30 Carl E. Brown

I believe the summary findings from the Geostrategies technical panel are an accurate reflection of our collective visions for the future. As one might expect these visions are somewhat clouded by our individual environments and realities. Certain of these visions are very encouraging while others are somewhat alarming. The thought of replacing human interactions with electronic message transfers is a regression, not a step forward. Humans have developed numerous ways to communicate beyond the spoken (or typed) word, mannerisms and body language can tell us a lot about a particular situation. We have learned to interpret (and sometimes exploit) this non-spoken form of communication. Being social creatures, the thought of a sterile, cold environment where individuals communicate only through electronic means and not through actual gatherings and meetings is definately not "foresight".

4:28) 05-FEB-2003 14:33 Adam L. Gruen

This fundamentally gets back to two kinds of futurism: advocacy and prophecy (alt:prediction).

In short, there is the future that you think is *possible*, the future that you think is *probable*, and the future you feel is *desirable*.

Quite frankly, nobody really wants to read another report on category I. But if you choose either the probable or the desirable, you have to explain why . . . and that gets messy.

4:29) 05-FEB-2003 15:40 John Verdon

I think there are some profound implication regarding the structure and culture of society and in particular of organizations regarding these technologies. It's not just a matter of maturing the technologies but of finding the social/cultural technologies that can leverage them. As a government employee, I have seen tremendous strides in the embedding of computers, then networked computers into the office environment with consequent implications on the needed skills. But we are so far away from being able to optimize their use to enhance productivity. The organizational structures to enhance their use are very slow in coming. Some of it is because Sr Management has been the lagging edge techno-peasant. A large part is that there is no organization that is dedicated to exploring/experimenting with effective org structures and their consequent cultures.

The Knowledge Management movement is the closest thing to furthering the transistions into the post-industrial org. Governance is the same issue but larger. We still have not engaged in the substantial debate on what privacy is (anonymity or the right to not be interfered with - a big difference). The freedom privacy issues have been explored by David Brin in "Transparent Society". The social/political dimensions will be much more influential on how these technologies deploy, their productive and their destructive consequences. Without serious thought to socio/cultural structures we will continue to be crisis reactive rather than shaping the emerging technologies to our benefit.

An illustration. As I understand it, the Germans, between the wars, used card board cut-out tanks to experiment with force structures and eventually developed a very effective organization of tanks and radio communication into the other forces.

Where is the experimentation center for effective office environments that optimize the full capacity of the geostrategic technologies to work locally and nationally?

4:30) 05-FEB-2003 16:01 Nicholas Carroll

"The Knowledge Management movement is the closest thing to furthering the transistions into the post-industrial org."

What is the KM crowd up to in Canada? In the U.S. it's mostly organisational engineering schemes (not buttressed by information science, either).

4:31) 05-FEB-2003 16:49 Jim W. Lai

Divergence for a moment. For those concerned that electronic mode communication will be too restricted, perhaps the Human Markup XML project might point to a blue sky representation where more of how we communicate as humans can be stored and transmitted.

<http://www.humanmarkup.org/>

4:32) 05-FEB-2003 18:26 Nicholas Carroll

Wish the site showed some actual markup.

4:33) 05-FEB-2003 19:09 Robert F. Johnston

I wonder also about the effect changing technology and scientific discovery has on human thinking processes. If the future is determined but unpredictable. That is, it cannot be predicted by any shorter process than just working it out. The universe is the fastest predictor. What does this do to our concept of free will and our desire to predict?

Or did the discovery of quantum mechanics lead to Existentialism?

If developments in the next 25 years change the way we think, this could have a much more profound effect on our world than the technologies we develop.

4:34) 05-FEB-2003 19:59 Jim W. Lai

Attempting to predict an exact point is futile. Quantum mechanics suggests it's still useful to frame things in terms of future possibilities, probability distributions, aggregate statistics (Bose-Einstein, Fermi-Dirac). IMO free will is a nonoperational concept and thus outside the realm of science. Humans have a strong drive towards loss avoidance, a strong motivation for developing predictive capacities. More to the point, being able to predict the competition provides an edge in both business and warfare. I don't see either field giving up on prognostication, even though it's not always successful.

4:35) 06-FEB-2003 01:09 John Verdon

I'm not sure that thinking processes have to change exactly. What is likely to be needed is an overlaying of operational processes. What is the difference in thinking processes of a classically trained musician in a traditional orchestra versus the Jazz musician playing with other professional Jazz musicians? Operational assumptions concerning how to proceed, how to improvise, how to communicate intentions, appreciations, and expectations about what the "product" is supposed to be. I assume that professional jazz musician can perform in the traditional orchestra but the traditional classically trained musician needs further training/education/experience with improvisation and collaborative improvisation.

It's not that we leave behind rational thinking processes but will require much more development of the creative "intuitive" (in the Jungian understanding of intuition - capacity to see wholes with only a few dots) integration of our sensorium.

4:36) 06-FEB-2003 06:15 Dirk Flinthart

The thought of replacing human interactions with electronic message transfers is a regression, not a step forward.

By and large, I'll agree with this, with two reservations. Firstly: we must always recognize that electronic message transfers also *enable* interactions which would not otherwise be possible... says the chap from Australia to the various Canadians, Americans, and others participating in this non-space.

Secondly: there are human interactions which are driven by forces which already degrade those interactions. ("Have a *nice* day, sir? Would you like fries with your Existentialism?) Where electronic messaging can relieve a person of that kind of duty, I don't really have a problem with it.

4:37) 06-FEB-2003 10:08 Bob Watson

"I wonder also about the effect changing technology and scientific discovery has on human thinking processes." (Robert, post 33)

I'm not sure there's much effect on the interior processing (some hardwired, some conditioned by culture), but if you think of "thinking processes" as tool-using then one can at least modify the tools that are at hand for use.

The Internet is already modifying our notions of "facts at hand" (a most recent US survey shows the Internet to have become more important than books and newspapers in this regard). I suggest that the Internet also has the potential to modify the cultural aspects of how we arrive at decisions (or, at least, enable the modification) -- this Caucus space is one example.

It may not be obvious, but I do think those of us who have been using such spaces for years and have successfully become involved in "intellectual virtual communities" are more apt to listen to, and heed, what others say than we may have before.

4:38) 06-FEB-2003 12:00 Peter Kallai

Just to add a word in on human interactions through "passing electronic messages" mentioned above by Carl.

In the Geostrategies workshop we came to the conclusion that human interactions, while they will be virtual, will be much the same as it is today. We somehow will be able to "smell, touch and feel" through virtual reality and get the pulse of an interaction. I expect that we as humans will have to learn these new ways of detecting what is going on, while a big portion of the extended sensing in the virtual interactions will be enabled by technology.

4:39) 06-FEB-2003 12:30 Howard Rheingold

Having written the book, *Virtual Reality* ten years ago, I am not so sanguine these days about the prospect that many people will be using it as a communication medium. For one thing, there are serious problems to be solved regarding the very slight system lag that can cause simulator sickness -- the more realistic the virtual world simulation, the more important this becomes. It isn't something that is easily solved by throwing processor power at it. Second, the coordination of multiple display modalities isn't as easy as building more powerful processing systems, and we know VERY little about realistic simulation of smell, touch, and feel, compared to the huge bodies of knowledge about visual and auditory perception. Finally, any new communication medium must compete with others -- what does VR provide that is that much better than voice, text, or multimedia but not immersive communications?

The "passing electronic messages" business is more complex than any simple statement can do justice. It reminds me of the ABC executive who quipped to me in 1993 that "the Internet is the CB of the 1990s" -- in other words, a fad. There are reasons why people adopt new media en masse -- because the media fulfill a need. For a much more detailed look at the pros and cons of mediate communications, the new chapter of my old book, which Moya helped research is available online: <http://www.rheingold.com/VirtualCommunity.html>

4:40) 06-FEB-2003 13:21 Jim W. Lai

Ran across an article about alien species in Africa and the harmful impact upon native ecologies, and it occurred to me that geographical monitoring of species invasions may assist into controlling such problems (e.g. zebra mussels). Could be a big task.

4:41) 06-FEB-2003 13:46 Donald Melanson

I tend to agree with Howard on this matter. Especially within the timeframe this workshop is looking at (2010-2025), I don't believe we'll see widespread use of virtual reality beyond specialized applications (engineering, gaming, etc.).

However, I do think we'll see many of the applications often associated with VR be adapted to non-VR or quasi-VR systems. Imagine something like a [CAVE system](#) being as common in conference rooms as a speaker phone. Currently, these systems use stereoscopic glasses but there are emerging technologies that could make them unnecessary (see [DTI displays](#)). These obviously wouldn't replace all the benefits of a full VR system, but for some applications, like telepresence, I think they'd be an adequate substitute, and would avoid some of the side-effects of VR that Howard mentioned

4:42) 06-FEB-2003 14:00 Nicholas Carroll

"For one thing, there are serious problems to be solved regarding the very slight system lag that can cause simulator sickness -- the more realistic the virtual world simulation, the more important this becomes."

Yep; remember the old trans-oceanic phone calls in which real conversation was impossible due to lag. Radio hams learn to adapt to that, but not fully. There is also a problem voiced by an East Indian who was using a high-end "virtual meeting room" at PARC some years ago: "No prana." He wanted to feel the life-force of the other participants. (I don't think that's an absolute. Some people can even radiate force of will and idea splendidly over a phone. But most can't.)

Further, there is a human factor to consider: many people feel they don't come across well in person, and will stubbornly stick to email under all but the most dire of circumstances. In fact nowadays some people refuse to use the phone. I've had people turn down contract work simply because I insisted on an occasional phone call. How will they react to being "on camera"? (Having sat in numerous Canadian media "green rooms", waiting for interview, I'd judge: not well. And do I have to quickly change shirts and brush my teeth every time the virtual phone rings?)

Of course, that might all change with the use of avatars. It could be a bit bizarre, of course. I'm not sure how I view the prospect of sharing a virtual meeting room with Mickey Mouse, Shakespeare, Marilyn Monroe, and Godzilla.

4:43) 06-FEB-2003 14:08 Howard Rheingold

For combat simulation and telesurgery, architecture, rational drug design, and a number of other specialties, however, I see VR growing more important -- it's already very important in combat simulation training.

4:44) 06-FEB-2003 14:24 Nicholas Carroll

Aye. Training is an application that cannot help but grow -- hugely.

4:45) 06-FEB-2003 16:46 John Verdon

I can accept the technical difficulties about VR, however, there is AR - augmented reality. Whereby the traditional neon lights that beacon and advertise are replaced by "hypertext-like" cyber notes perceivable with the right glasses. E.g. walking down the street the info-tags can tell me the street, address, what's inside each building. Navigation messages, sales in progress and a whole world of teaching aids. Imagine that with the right program I can see and hear the word for things that I point out (whether that be to help me learn another language, or to overcome a learning disability).

I have read that the US army is testing such a system in preparation for Iraq. Heads up displays on which locational information is displayed in order to avoid the "Black Hawk Down" syndrome.

4:46) 06-FEB-2003 16:48 Howard Rheingold

AR is useful in many contexts -- repairs, surgery, construction, military, educational. As long as it doesn't have to be immersive or perfectly coregistered with reality, the objections I raised don't apply.

4:47) 07-FEB-2003 21:50 Phil Staal

I've finally reviewed the report and posts -- sorry to be late in joining the discussion.

One issue that seems to be referred to obliquely in a number of places (hope I'm not overlooking something obvious) relates to decision-makers/politicians.

The visions presented describe very complex systems that are modelled by very complex models whose outputs may be hard to explain to decision-makers/politicians. Our current democratically elected suite of decision-makers/politicians doesn't fill me with confidence that it will be easy to present such people with the information that they require in a suitable format that will allow them to make rational decisions and be able to explain those decisions to their constituents. I worry that poor decisions may be made because of a lack of ability to understand how to handle complexity, and a possible retreat to simple "solutions" that are easy to sell. (and I think we've seen a few examples of this type of approach in the 1990s.)

Can technology offer solutions to this issue? Will "virtual reality worlds" help decision-makers and the public understand what decisions should be taken? Will people believe the results expressed in "virtual reality worlds" if they can't understand the workings of the models? or will they distrust the models and fall back to "simple truths"?

Can technology compensate for ham-handed politicians who make crude decisions based on inappropriate factors and simple models? Can technology help create a better crop of decision-makers?

4:48) 08-FEB-2003 07:17 Dirk Flinthart

I would personally like to see some of this upcoming Magic Modelling Technology applied to the "science" of economics. In Australia -- and from what I can see, America too -- politicians make decisions based on their personal ideologies, but they hold up the voodoo doll of 'economics' to sell their own prejudices to the public. If we're going to accept that massive computing power will really- truly yield powerful models of complex systems, then I would argue that first and foremost, we need to turn that power towards the economic structures of the world.

With a little luck, it would strip away one layer of excuses, forcing politicians to come up with more concrete reasons to spend money on their own fantasies. But so far as I can see, there will be no change to the process of spending.

By the way: since we're talking about the use of computers in politics, has anyone taken into account the trend towards total computerisation of voting in the USA -- and the opportunity it provides

politicians (particularly those who own computing and software firms that *make* voting machines) to achieve absolute control of the public agenda, while maintaining a figleaf of democratic process?

4:49) 08-FEB-2003 12:03 Robert Crosby

Good point, Dirk.

It is commonly believed that marijuana generates more revenue for the state of Hawaii than all other cash crops combined, including sugar, coffee, pineapples and macadamia nuts. Though unreported, these are real dollars that do circulate in the local economy. Yet, since it is illegal, it officially doesn't exist, nor is it factored in to any of the official analyses, forecasts or reports produced by economists purporting to understand Hawaii's economy.

Perhaps not surprising for a field in which two people can get a Nobel Prize for saying exactly the opposite thing (e.g. Myrdal and Hayek).

4:50) 09-FEB-2003 06:25 Dirk Flinthart

Yep. And in Queensland, best figures suggested that marijuana was the second or third largest cash crop when I lived there a few years back. (I hasten to add that my living there had almost nothing to do with the success of marijuana as a cash crop... I believe it is still doing very well despite the fact that I now live in Tasmania.)

Actually, there's a place to apply a lot of this ability to trace, track, and model: just how big is the 'black economy'? Where does the money go? WHERE does it come from?

4:51) 09-FEB-2003 17:31 Hervey Gibson

What Robert is saying is that marijuana in Hawaii employs around 10 000 people and generates more than half a billion dollars at farmers' prices.

Well, maybe. That's a lot to hide, and I wonder what the street value of all that hash would be?

But I'm sure none of us would want to dismiss chemistry, biology or physics on the basis of what we could have read in the newspapers a century or so after it was invented. You model the 'black economy' by looking for incomes that apparently aren't merited, or expenditures that aren't supported out of income or savings. The social accounting matrices and input output tables to do it were invented by another couple of Nobel laureates, Dick Stone and Wassily Leontief, over the 30s and 50s, and their 'science' only started to turn to 'engineering' in the 1970s when the UN started promulgating standard systems of national accounts. These do take formal account of the black economy, making them add up is one of the key ways to estimate the impact of drugs in places like Colombia. There's a good set of tables for Hawaii on the government website and I assure you that the social accounting principles work well in Canada too, and are a good starting point for estimating the role of irregular crops even in the Shangri Las of the BC interior.

Economics is coming along fine, and its an exciting science, but there are a few charalatang and ignorant people out there, and lots of us honestly groping in the dark, just as I am sure there were lots of physicists 40 years after the laws of the conservation of matter were promulgated.

And at the micro level the tracing and tracking of transactions in the black economy is exactly how some of the successes there are at rounding up Al Qaeda and co are being achieved - these days the Feds don't freeze and confiscate assets, but sit and see where the bank accounts are being filled up from and where they are being emptied to.

Dirk is quite right that the progress of economics is an important aspect of this scientific foresight debate. Its salutary to consider it alongside the progress of intercontinental telecommunication, which is the main medium for the debate. "America went mad with joy when, on the ever-memorable 5th of August 1858, the message rang across the Atlantic - 'Europe and America are united by telegraphic communication. Glory to God in the Highest, on earth peace, good will towards men'" . Kelvin's transatlantic cable lasted only a few weeks. Telstar came more than a century later, and an effective internet 30 years after that, and what we use now has required the major shift from electrons to photons.

Computing power already gives us the possibility to get away from some of the more sterile bits of macroeconomics, some of which were computational shortcuts because in the 1890s and 1930s there was no easy way to add up up how millions of individual agents might react. Nowadays good models of the economy build it up from lots of elements, but within a coherent systems view. I encourage you all to bring your systems modelling, design and engineering experience to economics. You'll be pleasantly surprised to find that not everyone already working in the field is a politician's poodle. In fact, as one of our great men said, what the politician's say is very often the thoughts of some long dead economist.

4:52) 09-FEB-2003 18:41 Robert Crosby

Good answer, Hervey. It changes my (admittedly ignorant) view of economics.

4:53) 11-FEB-2003 01:35 Charles Cameron

We are talking here about

geo-spatial data and related knowledge management technologies

The superposition of data on landscape is an old human trick, practiced by the shamans of Australia (see Bruce Chatwin, [Songlines](#)) and elites during the Classical, Mediaeval and Renaissance periods (see Frances Yates, [The Art of Memory](#), and Jonathan Spence, [The Memory Palace of Matteo Ricci](#), etc.

We forget, for instance, that our computers, logic machines *par excellence*, have in their family tree not just von Neumann (who also gave us the Theory of Games) but also Boole (who gave us Boolean logic, but also wrote a sonnet to the Trinity), Pascal (the man who said "the heart has reasons reason knows not of"), Leibniz and the Chinese I Ching (which, amazingly, Leibniz studied, and from which he derived much of his interest in binary systems)... or that the internet has prefigurations in Teilhard de Chardin (the *noosphere*), Hua-Yen Buddhism (the "net of Indra"), and Hermann Hesse (the *glasperlenspiel* or Glass Bead Game).

Generalization:

At least one member of a scenario team should be a rememberer (I have the feeling I'm almost quoting Robert Silverberg here), whose function is to recall earlier instantiations of a given principle – and thus some of the undertows and archetypal influences to which it may be subject.

*

Wah-wah-wah, very nice, science fiction, religion, myth, bed-time reading... sheer fantasy.

Except.

Except that every one of these precursors has something to teach us about the uses to which we are putting analogical ideas to use today – often in such a way as to "humanize" their use and impact. Hidden in Hesse's Bead Game, for instance, are clues to the way in which to move up the ***data > information > knowledge > wisdom*** ladder, and particularly how to make that last transition (which correlates strongly with "systems" and "holarchic" thinking and the inclusion of qualitative, affective, cultural and psychological elements in modeling...

If I may take an example from the preamble to this conference discussion item:--

As an example, in order to make the best possible decisions about coastal zone areas, one must explore over 20 interdependent factors, such as land use, economic activity on shore, the fishery, climate, weather, vegetation, salination, coastal erosion, etc.

This creates tremendous complexity in decision analysis and decision making. In ideal conditions, scientists would collect all required data on all factors and interdependencies to create a complex model to simulate decision(s) and decision impacts.

*Land use, economic activity on shore, the fishery, climate, weather, vegetation, salination, and coastal erosion are all essentially quantifiable matters, and can thus be modeled in STELLA type manner which can even include some very broad strokes affective measures: but **geo-spatial data and related knowledge management technologies**, if designed with sensitivity to the implications of the Art of Memory and Songlines referenced in my previous post would include "sense of place" as well as "transaction space" in it's overlay – and thus allow such imponderables as beauty, affection, memory, desire, vision to be brought into what otherwise must remain a somewhat arid calculation.*

*

It is the *human >> affective >> qualitative realm* that is all too often forgotten in our modeling, policy analysis and decision making, yet it is that realm which comes back to bite us – in the form of disaffection, revolt, antagonism, and even terrorism.

Freud coined the term *the return of the repressed* to describe the way in which problems all too often arise from the one zone we consistently fail to study: that area of study we might call "the neglected". By definition, this is a neglected area, it's true because it's tautological – but it's also an area we can consciously add to our list of necessary fields of research, if we'd only have the wits to do it.

Nrc Technology Foresight Workshop Item 4

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Nrc Foresight Workshop

Item 5

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Transformative and Disruptive Technologies

Item 5 02-FEB-2003 08:33 Moya K. Mason

What transformative and disruptive technologies could be potentially coming to fruition in the next decades, and in what ways could Canada play a role? What are the sleepers that might surprise us all?

We have identified the following:

1. Nanotechnology that promises large scale integration and miniaturization;
2. New designer materials; engineered for their desired characteristics;
3. Ever increasing processing power of microcircuits (in line with Moore's Law);
4. The internet, which is a great tool for information, resource sharing and for the creation of knowledge networks;
5. Smart systems and agents that can understand the meaning of words (semantics) in order to implement meaningful queries of databases and the Internet and synthesize data into information;
6. Autonomic software that is capable of self-repair and automatic code generation;
7. Wireless communication that will revolutionize social organization and interaction;
8. Fuel cells that can power remote sensors for extended periods;
9. Robotics and nanorobotics that will help action decisions;
10. Organic sensors that will enable us to use plants and other life forms to act as alert mechanisms;
11. New virtual reality-based visioning tools that allow citizens to participate widely in consultations and the decision-making process;
12. New human-machine interfaces that allow for more effective interaction. e.g. direct link between systems and the brain; and,
13. Telepresence that mimics the look and the feel of humans being in a meeting or perform activities such as diagnosis and surgery remotely.

5:1) 03-FEB-2003 12:18 David Crabtree

New technologies arising from a deeper understanding of space-time at the Plank scale:- theoretical work on "quantum gravity" is advancing along at least 3 avenues. This work may result in a new revolution in Physics within the 30 year horizon of the present S&T Foresight Pilot Projects and possibly much sooner. New technologies so dependent on theoretical advancement are impossible to imagine and little can be said about them except that humans will use them to counter threats and seize opportunities, if they are still in charge. However, the new technologies could well define a new era. Just remember the technological consequences of the Special and General Theories of Relativity and of Quantum Theory beginning early last century.

 5:2) 03-FEB-2003 12:36 Charles Cameron

Thanks, David.

New technologies so dependent on theoretical research are impossible to imagine and little can be said about them ...

There's a sort of cognitive singularity, isn't there, whereby we can't envision futures past the *unintended consequences* of those aspects of the future which we *can* envision. I hope that's not too tautologous. I think what you're saying here is something similar, only with the words *emergent properties* substituted for *unintended consequences*, perhaps?

Future studies, scenarios etc tend to focus on what *can* be imagined, of course, so there's a discrepancy between what scenarios hold and what the future itself may deliver, that's worth investigating in its own right -- perhaps if futurists spent a proportion of their time staring zennishly at a blank wall, they'd be able to intuit the unknowable <grin>.

... except that if humans are still charge they will use them to counter threats and seize opportunities.

... always remembering that one person's seized opportunity is another person's threat to be countered.

 5:3) 03-FEB-2003 12:51 David Crabtree

We may be defining a boundary beyond which S&T Foresight becomes ineffective. Is it possible and at the same time productive to extend the methodology beyond to consideration of scenarios that to some extent depend for their description on theoretical work that remains, for the present, incomplete?

 5:4) 03-FEB-2003 12:57 Howard Rheingold

Sure, David. In my somewhat limited exposure to scenario planning, two key elements are driving forces and critical uncertainties. The need for increasing amounts of energy is a driving force, for example, but whether or not there will be a theoretical breakthrough in regard to fusion or other radically new energy sources is a critical uncertainty. One can consider scenarios where breakthroughs occur. Sudden access to inexpensive energy worldwide could have disastrous consequences, for example (global warming could accelerate).

5:5) 03-FEB-2003 14:37 Raymond Bouchard

I believe it was William Gibson (Neuromancer) who said that the future is already here, it's just unevenly distributed. There are many scenarios that could occur with a relatively minor tweaking of environmental variables.

A case in point is the impact of bio-nano-cogno-info-systemo technologies. Having just spent a few hours this morning explaining how health delivery systems are going to be transformed by bio-sensors and transgenic xenotransplants and all the other reasonably forecastable technology, I couldn't avoid the fact that there is a Plan B: getting plenty of sleep, eating properly, exercising, not smoking, drinking plenty of water etc.

The "naturally healthy" scenario is very plausible and actually pursued by many, although often without success. One could imagine (after having read Howard's book) that we could have "virtual support groups" that could keep us on the straight and narrow via a wireless network.

5:6) 03-FEB-2003 15:23 Howard Rheingold

Health delivery systems transformed by bio-sensors:
<http://www.smartmobs.com/archives/000635.html>

5:7) 03-FEB-2003 20:03 Dirk Flinthart

Number six: Autonomic software that is capable of self-repair and automatic code generation

This one is the kicker for me. From a number of speculative sources, and some consideration, I have developed a private suspicion that 'consciousness' as we know it may well arise from "self-checking" routines that develop in complex neural structures. Any "self-checking" routine must necessarily have some model of the overall object or organism that it's supposed to check or repair. It's not a long step from there to something indistinguishable from 'self-awareness'.

5:8) 04-FEB-2003 08:15 Drew Fullerton

All well and good folks. As indicated in the 2 docs, this is all highly speculative based on brainstorming...what next? I suggest we need to develop a methodology to actually "identify" centres of gravity where resources are being invested so that we can start to get a sense of what technologies we can expect to see emerge/succeed sooner rather than later. Let's put together a credible roadmap...a product would may be of some use

5:9) 04-FEB-2003 08:35 Ingar Moen

Let me add our perspective to the discussion for comment

The Future Defence Technology Landscape

The future technology landscape will continue to evolve at an accelerated pace. Increasingly, we will see the influence of commercial technologies on military systems. DRDC's Technology Outlook Thrust was conceived to identify emerging technologies, assess their potential relevance to Canadian defence and provide advice on the impact of S&T development on national and departmental policies and strategies. Assessments of emerging technologies are conducted and technology watch methodologies are being refined and applied in the defence context to provide early warning of developments in S&T.

The hardware that enables information technology will continue to evolve, yielding more processing power, memory and speed. Computers will be everywhere, with chips embedded in equipment and clothing. Microprocessor chips, 10,000 times more powerful than we use today, are possible with revolutionary new technologies. Optical computing is just around the corner, and quantum computing is on the horizon. The challenge will be to develop software that can manage the growing amount of information. To quickly take advantage of new developments, modular object-oriented software systems are required that can easily be upgraded.

As our knowledge of specific genes and their interactions increases, the techniques of recombinant DNA, cell fusion and gene splitting will enable the transfer of complex multi-gene characteristics into cells and organisms. Substances with new properties will be produced, such as those for discrete recognition of a particular organism, compounds that modify biological responses, artificial body fluids and new foods. Advances in the medical sciences, such as artificial blood, rapidly growing skin and tele-medicine, will reduce requirements for on-site medical support in all military operations.

Genetic engineering offers the prospect of providing treatments and cures for most diseases, and genetically modified crops will offer the potential to improve the nutrition of the world's mal-nourished people.

Our increasing understanding of the brain will provide clues to the origins of conflicts and the psychology of warfare. Electronic devices that couple directly to the brain are already available. Safe drugs will be available to temporarily enhance cognitive and physical performance. The improved fidelity of simulators will allow a shift to training in virtual environments. Improved training

methods will reduce training periods from months to weeks.

Through the skillful incorporation of smart sensors, adaptive control (computer) systems, and actuators (active systems), smart structures will be developed that can adapt themselves to changes in operating conditions or environmental parameters, thus exhibiting greatly enhanced performance. Networks of sensors, systems and weapons will provide robust enhancements to battlefield information flow and weapons effectiveness.

Molecular manufacturing – the ability to design and manufacture devices that are only tens or hundreds of atoms in dimension - promises rich rewards in electronics, sensors, and materials. The usefulness of molecular manufacturing depends on the ability to produce large enough structures and sufficient quality and quantity to be effective. While this may not become a reality within the next ten years, a wide range of micro-electronic mechanical systems (MEMS) will be available, incorporating various sensors, actuators, transmitters and power sources on a single chip. Development of future MEMS and nanotechnology devices may ultimately rest on the ability to manufacture and package adequate power sources. In fact, power sources, from tiny batteries to megawatt diesel generators, are key to all military operations. New equipment and systems enabled by advanced technologies will require reliable power sources. Numerous power generation technologies are currently being evaluated, including fuel cells, hydrogen as fuel for engines and turbines, molecular motors, boot-heel strike electrostrictive power, micro-turbogenerators that can be embedded into handheld devices, and chip-mounted electric devices for portable power generation and storage.

Robotic Systems will be fully exploited on the future battlefield (e.g., micro robots for surveillance and target identification, and robotic weapon systems). Primary roles will include early sensing and shaping of the battlespace prior to and during force deployment. Robots or remotely controlled platforms, such as unmanned combat air vehicles and tanks, will be common on the battlefield in the near future. Developments in autonomous systems will also allow reduced crew for most platforms.

Space will be an increasingly important component of the global security environment. For future coalition warfare, space superiority will be fundamental to coalition defence posture and operations. Advances in microstructural materials, nanotechnologies, highly efficient power sources and cheaper launch vehicles will continue to drive down the cost of space systems and make it increasingly economical to deploy wide area surveillance and early warning systems in space. Trends evident in the development of space systems include the increasing availability of high-resolution commercial imagery satellites, smaller satellites with greater on-board processing power, assembly-line production of constellations of satellites, and concerted efforts to develop less expensive launch vehicles.

New technology applications will also be needed to monitor and deal with emerging global security issues such as population growth, ecological degradation, infectious disease, and the safety and security of food and water resources. Global warming will also challenge the international

community as indications of a warming climate occur, such as meltbacks of polar ice, sea level rise, and increasing frequency of major storms.

5:10) 04-FEB-2003 10:17 Charles Cameron

It's helpful to have a listing like the one you present, Ingar, but also important to pause over each item in the cascade and ask, what are the implications, what are the entailments here. When you write, for instance,

Our increasing understanding of the brain will provide clues to the origins of conflicts and the psychology of warfare

[one item from your list that positively clamored for further comment] should we envision this increasing understanding as providing "enhanced" warfighters, or as a means of conflict resolution, or both?

And having sorted out the individual skeins and then examined their implications, we next need to consider the crosscuts between them.

5:11) 04-FEB-2003 13:32 Nicholas Carroll

Yes, that phrase popped out at me too. There is a sort of implicit acceptance of cyborgism, mind enhancement, and -- dast we say it? -- mind control running through the BioSystemics and Geostrategics reports.

5:12) 04-FEB-2003 13:41 Donald Melanson

This Mindjack article: [The Future of Infantry](#), written by Jim Lai, another participant here, might be of some relevance.

5:13) 04-FEB-2003 13:56 Charles Cameron

Thanks for that, Donald and Jim. There's also the mental enhancement side of things, for instance:

Future soldiers could get enhanced minds

Monday, 19 March 2001 21:21 (ET)

<http://www.vny.com/cf/News/upidetail.cfm?QID=169532>

[quoted in full because no longer available at this site]

WASHINGTON, March 19 (UPI) -- Researchers hope to use advances in computers, communications and neuroscience to medically enhance the mental acuity of future soldiers, while connecting their body and minds to smarter machines.

"Military planners are looking to science to find better ways to exploit

human perception and memory," said Dr. Dennis McBride, a former naval officer and a professor in the department of psychology and engineering at the University of Central Florida in Orlando.

"Thanks in part to MRIs we can actually see mental processes, or correlates of mental processes," McBride said. "That will one day help us to find ways, for example, to help information in the human brain move more quickly from short-term store to long-term store."

McBride said scientists might be able to boost mental awareness, regulate mood, control anxieties and more, using custom-tailored medicines whose effect and dosage are based on genetic information and delivered by novel methods made possible through nanotechnology. Pharmaceutical companies are leading the way in developing drugs to those ends, but the most pressing challenge is avoiding side effects, he said.

One key to augmenting the thinking of tomorrow's soldiers is learning more about how emotion affects decision-making, specifically learning how emotional attachments and highly stressful situations effect the brain's ability to retrieve information.

McBride said the Navy has sponsored a research program, called tactical decision-making under stress, that has lead to an important understanding of the co-relationship between emotion and cognition. But real advances will occur when tomorrow's soldiers, perhaps already biologically enhanced through drugs, are seamlessly integrated with small, powerful computers.

"It will likely be possible that the future soldier, for instance, will wear eyewear that allows him to see a person and instantaneously be presented with a complete dossier on who that person is," McBride said.

He also described a video chip that might one day record a soldier's sensory experiences and perceptions and download it for access by other soldiers.

"We have developed drugs that have proven to enhance mental acuity in animals, and we are very optimistic that they can be tailored for human use," said Dr. Dan Alkon, formerly of the National Institutes of Health and now scientific director of the Blanchette Rockefeller Neurosciences Institute, co-sponsored by Johns Hopkins University in Baltimore and West Virginia University in Morgantown.

"We have extracted mathematical principles to find and map neurological systems, then developed drugs that enhance those systems. From the perspective of warfighting, this is a great wave of the future."

But many social and ethical considerations exist, as demonstrated by a publication entitled "Out of the Box and Into the Future," released by the Potomac Institute for Policy Studies in Washington, D.C.

The publication cites a paper that highlights these worries: "Our understanding of all human social arrangements is based, ultimately, on an understanding of human nature. If that nature becomes subject to significant alteration through human artifice, then all such arrangements are thrown into doubt. Can humanity trust itself with such capabilities? Should it? How can we know before the fact?"

(Reported by Technology Writer Kelly Hearn in Washington)

This article reprinted in full without permission for the purposes of discussion and review, as permitted by Section 107 of the U.S. Copyright Act of 1976.

Note the caveat from a Potomac Institute paper quoted at the end of the article, which speaks to Nicholas' point above.

5:14) 04-FEB-2003 14:07 Jim W. Lai

Sociology (cognitive sociology?) has much to offer with regard to the workings of the mind, and thus conflict-related applications there to. Cultural biases, such as the relative dominance of analytical versus dialectical thought processes and attribution models (individual action versus group-relational action), also play in conflict. Mere modelling of consciousness alone is insufficient, though it's a foundational step.

Cultural biases will of course also shape which technologies achieve broad acceptance, and how quickly the uptake rate will be (assuming suitable economies of scale). Americans being more individualistic may resist some of these technologies more so than Canadians might.

Dependence on a mass communication infrastructure for combat and civilian purposes will lead to the development of new (novel?) infrastructure countermeasures/attacks.

5:15) 04-FEB-2003 15:39 Adam L. Gruen

Is this conference at some point also going to talk about *how* technologies are brought into being? Because disruptive and transformative technologies (not to mention reinforcing and incremental improvement technologies) don't just "happen", you know. They need to be brought into being -- and usually for specific reasons.

5:16) 04-FEB-2003 15:47 Nicholas Carroll

<Adam slipped in>

Doubtless some of the enhancement efforts will work. As an American recon patroller explained his personal method of combining dexedrine and Seconal: "One to cut the trail, and the other to send you down it. They sure give you the range."

On the other hand, US Army experiments with clinical psychopaths were a fiasco.

5:17) 04-FEB-2003 15:52 Nicholas Carroll

Adam, for some reason that reminds me of those hilarious B&W movies about the early experiments with flying machines. The chaos of basic research is certainly different from R&D.

5:18) 04-FEB-2003 16:58 Adam L. Gruen

Well, technology development cuts both ways. Some of it is funded in order to solve "pressing" needs, that is to say, incremental improvements in existing systems. An example would be a flashlight battery that lasts twice as long and costs half as much to produce, all other things being equal (toxicity in production, disposal cost, etc.) Instant winner. Some of it is funded to "leapfrog" anticipated problems. An example would be the jet engine invented in the 1930s, when piston-driven engines worked fine and were being incrementally improved through the wazoo, but in which a theoretical limit was perceived and recognized.

So was the jet engine transformative? Well, in one sense yes it was. It redefined air travel. But OTOH, it wasn't teleportation either, and did fit with an established industry.

Anyway, so getting back to the U.S.\$64 question -- who is going to fund what, with what objective, over what timeframe, for what specific purpose?

5:19) 05-FEB-2003 06:10 David Brake

One of the items caught my eye:

"New virtual reality-based visioning tools that allow citizens to participate widely in consultations and the decision-making process"

There are a few un-spoken premises here - will virtual reality actually help people to understand complex details? It may, but I suggest some research will be needed to understand what interfaces work best at communicating information. Similarly, the "information architecture" of virtual community building is still in its infancy. We have the tools to build online systems to encourage citizen participation but I am not convinced we know enough about how such environments should be structured, socially and technically, to encourage maximum participation - not just by the most motivated but by people with poor writing skills or who find dealing with computers difficult.

It is possible to create asynchronous message boards like this one using recorded voice, for example, instead of typing, but how would such a thing be indexed?

5:20) 05-FEB-2003 14:32 David Harries

Thanks everyone for contributing mightily to my thoughts and pictures!

I am keen on "deliverables", as hard as that seems to be when we are working intellectually so far "out"/"away".

One deliverable I believe we need more and more each day is what might be called a strong "tow rope", or an unbreakable "bungee cord".

Looked at globally, one of the universal "disruptive technologies" is technology. The gap/divide/distance between those at the "front" of the pack and those at the back is growing. Those at the back are - by design or default - more and more aware of their position. Most do not like being "behind", even less so becoming farther and farther behind.

People, parties and politics who come to dislike something intensely enough tend to do something about it; maybe something transformative, and bad - very bad - for themselves and others. Some, who may have no interest whatsoever in "technology" matters, use it, or borrow it for a reason to justify something they want to do; maybe something bad or worse.

Thinking about transformative and disruptive technologies should include a minute or two on "tow ropes" or "bungee cords" to use to reduce the number of those falling farther and farther behind....

It might be something very simple, but six years in SE Asia convinced me that it is needed.

5:21) 05-FEB-2003 14:53 Ahmed Shalabi

Most of my concerns with Technology is the philosophy behind the science - I highly recommend a book by Samir Okasha on the same subject matter, and Colin McGinn's *The Making of a Philosopher: My Journey Through Twentieth-Century Philosophy*;. As as the following Resource material:

Scientific Method: Inductivism, Falsificationism etc: What Is This Thing Called Science? by Alan F. Chalmers. For popperian refutation: you can read popper's "the logic of scientific discovery" or more vulgarized versions like Bryan Magee's *Philosophy and the Real World: An Introduction to Karl Popper*. I have attached an article by Richard Feynman on "Cargo Cult Science" from a Caltech commencement address given in 1974. Food for thought before defining the future.

During the Middle Ages there were all kinds of crazy ideas, such as that a piece of of rhinoceros horn

would increase potency. Then a method was discovered for separating the ideas--which was to try one to see if it worked, and if it didn't work, to eliminate it. This method became organized, of course, into science. And it developed very well, so that we are now in the scientific age. It is such a scientific age, in fact, that we have difficulty in understanding how witch doctors could ever have existed, when nothing that they proposed ever really worked--or very little of it did.

But even today I meet lots of people who sooner or later get me into a conversation about UFO's, or astrology, or some form of mysticism, expanded consciousness, new types of awareness, ESP, and so forth. And I've concluded that it's not a scientific world.

Most people believe so many wonderful things that I decided to investigate why they did. And what has been referred to as my curiosity for investigation has landed me in a difficulty where I found so much junk that I'm overwhelmed. First I started out by investigating various ideas of mysticism and mystic experiences. I went into isolation tanks and got many hours of hallucinations, so I know something about that. Then I went to Esalen, which is a hotbed of this kind of thought (it's a wonderful place; you should go visit there). Then I became overwhelmed. I didn't realize how MUCH there was.

At Esalen there are some large baths fed by hot springs situated on a ledge about thirty feet above the ocean. One of my most pleasurable experiences has been to sit in one of those baths and watch the waves crashing onto the rocky slope below, to gaze into the clear blue sky above, and to study a beautiful nude as she quietly appears and settles into the bath with me.

One time I sat down in a bath where there was a beautiful girl sitting with a guy who didn't seem to know her. Right away I began thinking, "Gee! How am I gonna get started talking to this beautiful nude woman?"

I'm trying to figure out what to say, when the guy says to her, "I'm, uh, studying massage. Could I practice on you?" "Sure," she says. They get out of the bath and she lies down on a massage table nearby. I think to myself, "What a nifty line! I can never think of anything like that!" He starts to rub her big toe. "I think I feel it," he says. "I feel a kind of dent--is that the pituitary?" I blurt out, "You're a helluva long way from the pituitary, man!" They looked at me, horrified--I had blown my cover--and said, "It's reflexology!" I quickly closed my eyes and appeared to be meditating.

That's just an example of the kind of things that overwhelm me. I also looked into extrasensory perception, and PSI phenomena, and the latest craze there was Uri Geller, a man who is supposed to be able to bend keys by rubbing them with his finger. So I went to his hotel room, on his invitation, to see a demonstration of both mindreading and bending keys. He didn't do any mindreading that succeeded; nobody can read my mind, I guess. And my boy held a key and Geller rubbed it, and nothing happened. Then he told us it works better under water, and so you can picture all of us standing in the bathroom with the water turned on and the key under it, and him rubbing the key with his finger. Nothing happened. So I was unable to investigate that phenomenon.

But then I began to think, what else is there that we believe? (And I thought then about the witch doctors, and how easy it would have been to check on them by noticing that nothing really worked.) So I found things that even more people believe, such as that we have some knowledge of how to educate. There are big schools of reading methods and mathematics methods, and so forth, but if you notice, you'll see the reading scores keep going down--or hardly going up--in spite of the fact that we continually use these same people to improve the methods. There's a witch doctor remedy that doesn't work. It ought to be looked into; how do they know that their method should work? Another example is how to treat criminals. We obviously have made no progress--lots of theory, but no progress--in decreasing the amount of crime by the method that we use to handle criminals.

Yet these things are said to be scientific. We study them. And I think ordinary people with commonsense ideas are intimidated by this pseudoscience. A teacher who has some good idea of how to teach her children to read is forced by the school system to do it some other way--or is even fooled by the school system into thinking that her method is not necessarily a good one. Or a parent of bad boys, after disciplining them in one way or another, feels guilty for the rest of her life because she didn't do "the right thing," according to the experts.

So we really ought to look into theories that don't work, and science that isn't science.

I think the educational and psychological studies I mentioned are examples of what I would like to call cargo cult science. In the South Seas there is a cargo cult of people. During the war they saw airplanes with lots of good materials, and they want the same thing to happen now. So they've arranged to make things like runways, to put fires along the sides of the runways, to make a wooden hut for a man to sit in, with two wooden pieces on his head to headphones and bars of bamboo sticking out like antennas--he's the controller--and they wait for the airplanes to land. They're doing everything right. The form is perfect. It looks exactly the way it looked before. But it doesn't work. No airplanes land. So I call these things cargo cult science, because they follow all the apparent precepts and forms of scientific investigation, but they're missing something essential, because the planes don't land.

Now it behooves me, of course, to tell you what they're missing. But it would be just about as difficult to explain to the South Sea islanders how they have to arrange things so that they get some wealth in their system. It is not something simple like telling them how to improve the shapes of the earphones. But there is one feature I notice that is generally missing in cargo cult science. That is the idea that we all hope you have learned in studying science in school--we never say explicitly what this is, but just hope that you catch on by all the examples of scientific investigation. It is interesting, therefore, to bring it out now and speak of it explicitly. It's a kind of scientific integrity, a principle of scientific thought that corresponds to a kind of utter honesty--a kind of leaning over backwards. For example, if you're doing an experiment, you should report everything that you think might make it invalid--not only what you think is right about it: other causes that could possibly explain your results; and things you thought of that you've eliminated by some other experiment, and how they worked--to make sure the other fellow can tell they have been eliminated.

Details that could throw doubt on your interpretation must be given, if you know them. You must do the best you can--if you know anything at all wrong, or possibly wrong--to explain it. If you make a theory, for example, and advertise it, or put it out, then you must also put down all the facts that disagree with it, as well as those that agree with it. There is also a more subtle problem. When you have put a lot of ideas together to make an elaborate theory, you want to make sure, when explaining what it fits, that those things it fits are not just the things that gave you the idea for the theory; but that the finished theory makes something else come out right, in addition.

In summary, the idea is to give all of the information to help others to judge the value of your contribution; not just the information that leads to judgement in one particular direction or another.

The easiest way to explain this idea is to contrast it, for example, with advertising. Last night I heard that Wesson oil doesn't soak through food. Well, that's true. It's not dishonest; but the thing I'm talking about is not just a matter of not being dishonest; it's a matter of scientific integrity, which is another level. The fact that should be added to that advertising statement is that no oils soak through food, if operated at a certain temperature. If operated at another temperature, they all will--including Wesson oil. So it's the implication which has been conveyed, not the fact, which is true, and the difference is what we have to deal with.

We've learned from experience that the truth will come out. Other experimenters will repeat your experiment and find out whether you were wrong or right. Nature's phenomena will agree or they'll disagree with your theory. And, although you may gain some temporary fame and excitement, you will not gain a good reputation as a scientist if you haven't tried to be very careful in this kind of work. And it's this type of integrity, this kind of care not to fool yourself, that is missing to a large extent in much of the research in cargo cult science.

A great deal of their difficulty is, of course, the difficulty of the subject and the inapplicability of the scientific method to the subject. Nevertheless, it should be remarked that this is not the only difficulty. That's why the planes don't land--but they don't land.

We have learned a lot from experience about how to handle some of the ways we fool ourselves. One example: Millikan measured the charge on an electron by an experiment with falling oil drops, and got an answer which we now know not to be quite right. It's a little bit off because he had the incorrect value for the viscosity of air. It's interesting to look at the history of measurements of the charge of an electron, after Millikan. If you plot them as a function of time, you find that one is a little bit bigger than Millikan's, and the next one's a little bit bigger than that, and the next one's a little bit bigger than that, until finally they settle down to a number which is higher.

Why didn't they discover the new number was higher right away? It's a thing that scientists are ashamed of--this history--because it's apparent that people did things like this: When they got a number that was too high above Millikan's, they thought something must be wrong--and they would look for and find a reason why something might be wrong. When they got a number close to

Millikan's value they didn't look so hard. And so they eliminated the numbers that were too far off, and did other things like that. We've learned those tricks nowadays, and now we don't have that kind of a disease.

But this long history of learning how to not fool ourselves--of having utter scientific integrity--is, I'm sorry to say, something that we haven't specifically included in any particular course that I know of. We just hope you've caught on by osmosis

The first principle is that you must not fool yourself--and you are the easiest person to fool. So you have to be very careful about that. After you've not fooled yourself, it's easy not to fool other scientists. You just have to be honest in a conventional way after that.

I would like to add something that's not essential to the science, but something I kind of believe, which is that you should not fool the layman when you're talking as a scientist. I am not trying to tell you what to do about cheating on your wife, or fooling your girlfriend, or something like that, when you're not trying to be a scientist, but just trying to be an ordinary human being. We'll leave those problems up to you and your rabbi. I'm talking about a specific, extra type of integrity that is not lying, but bending over backwards to show how you're maybe wrong, that you ought to have when acting as a scientist. And this is our responsibility as scientists, certainly to other scientists, and I think to laymen.

For example, I was a little surprised when I was talking to a friend who was going to go on the radio. He does work on cosmology and astronomy, and he wondered how he would explain what the applications of his work were. "Well," I said, "there aren't any." He said, "Yes, but then we won't get support for more research of this kind." I think that's kind of dishonest. If you're representing yourself as a scientist, then you should explain to the layman what you're doing-- and if they don't support you under those circumstances, then that's their decision.

One example of the principle is this: If you've made up your mind to test a theory, or you want to explain some idea, you should always decide to publish it whichever way it comes out. If we only publish results of a certain kind, we can make the argument look good. We must publish BOTH kinds of results.

I say that's also important in giving certain types of government advice.. Supposing a senator asked you for advice about whether drilling a hole should be done in his state; and you decide it would be better in some other state. If you don't publish such a result, it seems to me you're not giving scientific advice. You're being used. If your answer happens to come out in the direction the government or the politicians like, they can use it as an argument in their favor; if it comes out the other way, they don't publish at all. That's not giving scientific advice.

Other kinds of errors are more characteristic of poor science. When I was at Cornell, I often talked to the people in the psychology department. One of the students told me she wanted to do an

experiment that went something like this--it had been found by others that under certain circumstances, X, rats did something, A. She was curious as to whether, if she changed the circumstances to Y, they would still do A. So her proposal was to do the experiment under circumstances Y and see if they still did A.

I explained to her that it was necessary first to repeat in her laboratory the experiment of the other person--to do it under condition X to see if she could also get result A, and then change to Y and see if A changed. Then she would know the the real difference was the thing she thought she had under control.

She was very delighted with this new idea, and went to her professor. And his reply was, no, you cannot do that, because the experiment has already been done and you would be wasting time. This was in about 1947 or so, and it seems to have been the general policy then to not try to repeat psychological experiments, but only to change the conditions and see what happened.

Nowadays, there's a certain danger of the same thing happening, even in the famous field of physics. I was shocked to hear of an experiment being done at the big accelerator at the National Accelerator Laboratory, where a person used deuterium. In order to compare his heavy hydrogen results to what might happen with light hydrogen, he had to use data from someone else's experiment on light hydrogen, which was done on different apparatus. When asked why, he said it was because he couldn't get time on the program (because there's so little time and it's such expensive apparatus) to do the experiment with light hydrogen on this apparatus because there wouldn't be any new result. And so the men in charge of programs at NAL are so anxious for new results, in order to get more money to keep the thing going for public relations purposes, they are destroying--possibly--the value of the experiments themselves, which is the whole purpose of the thing. It is often hard for the experimenters there to complete their work as their scientific integrity demands.

All experiments in psychology are not of this type, however. For example, there have been many experiments running rats through all kinds of mazes, and so on--with little clear result. But in 1937 a man named Young did a very interesting one. He had a long corridor with doors all along one side where the rats came in, and doors along the other side where the food was. He wanted to see if he could train the rats to go in at the third door down from wherever he started them off. No. The rats went immediately to the door where the food had been the time before.

The question was, how did the rats know, because the corridor was so beautifully built and so uniform, that this was the same door as before? Obviously there was something about the door that was different from the other doors. So he painted the doors very carefully, arranging the textures on the faces of the doors exactly the same. Still the rats could tell. Then he thought maybe the rats were smelling the food, so he used chemicals to change the smell after each run. Still the rats could tell. Then he realized the rats might be able to tell by seeing the lights and the arrangement in the laboratory like any commonsense person. So he covered the corridor, and still the rats could tell.

He finally found that they could tell by the way the floor sounded when they ran over it. And he could only fix that by putting his corridor in sand. So he covered one after another of all possible clues and finally was able to fool the rats so that they had to learn to go in the third door. If he relaxed any of his conditions, the rats could tell.

Now, from a scientific standpoint, that is an A-number-one experiment. That is the experiment that makes rat-running experiments sensible, because it uncovers that clues that the rat is really using--not what you think it's using. And that is the experiment that tells exactly what conditions you have to use in order to be careful and control everything in an experiment with rat-running.

I looked up the subsequent history of this research. The next experiment, and the one after that, never referred to Mr. Young. They never used any of his criteria of putting the corridor on sand, or being very careful. They just went right on running the rats in the same old way, and paid no attention to the great discoveries of Mr. Young, and his papers are not referred to, because he didn't discover anything about the rats. In fact, he discovered all the things you have to do to discover something about rats. But not paying attention to experiments like that is a characteristic example of cargo cult science.

Another example is the ESP experiments of Mr. Rhine, and other people. As various people have made criticisms--and they themselves have made criticisms of their own experiments--they improve the techniques so that the effects are smaller, and smaller, and smaller until they gradually disappear. All the para-psychologists are looking for some experiment that can be repeated--that you can do again and get the same effect--statistically, even. They run a million rats--no, it's people this time--they do a lot of things and get a certain statistical effect. Next time they try it they don't get it any more. And now you find a man saying that is is an irrelevant demand to expect a repeatable experiment. This is science?

This man also speaks about a new institution, in a talk in which he was resigning as Director of the Institute of Parapsychology. And, in telling people what to do next, he says that one of things they have to do is be sure the only train students who have shown their ability to get PSI results to an acceptable extent--not to waste their time on those ambitious and interested students who get only chance results. It is very dangerous to have such a policy in teaching--to teach students only how to get certain results, rather than how to do an experiment with scientific integrity.

So I have just one wish for you--the good luck to be somewhere where you are free to maintain the kind of integrity I have described, and where you do not feel forced by a need to maintain your position in the organization, or financial support, or so on, to lose your integrity. May you have that freedom.

5:22) 05-FEB-2003 15:06 Bob Watson

Nice item, Ahmed. How would you apply it to the situation today?

5:23) 05-FEB-2003 15:11 Adam L. Gruen

[slipped by Bob]

Details that could throw doubt on your interpretation must be given, if you know them. You must do the best you can--if you know anything at all wrong, or possibly wrong--to explain it. If you make a theory, for example, and advertise it, or put it out, then you must also put down all the facts that disagree with it, as well as those that agree with it. There is also a more subtle problem. When you have put a lot of ideas together to make an elaborate theory, you want to make sure, when explaining what it fits, that those things it fits are not just the things that gave you the idea for the theory; but that the finished theory makes something else come out right, in addition.

Fascinating. That is almost exactly how I was taught to do historical research and writing. You have a theory, you prove it to the best of your ability, and then you spend the rest of your time trying to disprove it. Or at least to show how your theory fits the data better than some other theory.

5:24) 05-FEB-2003 15:31 Ahmed Shalabi

Not sure. I guess we can always stress the 'Ph' in 'PhD'. How ? Perspectives to 'free-up' the neurons: 10 days without TV, 2 months without the computer, lots of courses in history, art & music , then -if time permits - a dissertation in logical structure & explanatory coherence. This would change the future trend(s) of how science is being done.

Yes - In 10 Years We May Have No Bananas

James Meek, science correspondent
Thursday January 16, 2003
The Guardian

It is a freakish, doped-up, mutant clone which hasn't had sex for thousands of years - and the strain may be about to tell on the nation's fruitbowl favourite. Scientists based in France have warned that, without radical and swift action, in 10 years' time we really could have no bananas.

Two fungal diseases, Panama disease and black Sigatoka, are cutting a swath through banana plantations, just as blight once devastated potato crops. But unlike the potato, and other crops where disease-resistant strains can be bred by conventional means, making a fungus-free variety of the banana is extraordinarily difficult.

Emile Frison, head of the Montpellier-based International Network for the Improvement of Banana and Plantain, told New Scientist magazine that the banana business could be defunct within a decade. This doesn't just mean we will be eating aubergine splits and that future governments may be mocked for policy melon skins. The banana, in various forms, is the staple diet for some half billion people in Asia and Africa.

Almost all the varieties of banana grown today are cuttings - clones, in effect - of naturally mutant

wild bananas discovered by early farmers as much as 10,000 years ago. The rare mutation caused wild bananas to grow sterile, without seeds. Those ancient farmers took cuttings of the mutants, then cuttings of the cuttings.

Plants use reproduction to continuously shuffle their gene pool, building up variety so that part of the species will survive an otherwise deadly disease. Because sterile mutant bananas cannot breed, they do not have that protection.

Commercial banana plantations were devastated in the 1950s when Panama disease slew the dominant variety, the Gros Michel. A resistant variety, the Cavendish, filled the gap. But only massive amounts of fungicide spray - 40 sprayings a year is common - now keep Sigatoka at bay, and a new version of Panama disease cannot be sprayed. The Amazon banana crop has been devastated by the fungi, and according to Mr Frison, some parts of Africa now face the equivalent of the Irish potato famine.

One possibility is GM bananas, but growers fear consumer resistance. The big growers are pinning their hopes on better fungicides.

One ray of hope comes from Honduran scientists, who peeled and sieved 400 tonnes of bananas to find 15 seeds for breeding. They have come up with a fungus-resistant variety which could be grown organically. If bananas don't disappear from supermarket shelves by 2013, they will look, and taste, different.

Guardian Unlimited © Guardian Newspapers Limited 2003

5:25) 05-FEB-2003 15:36 Bob Watson

I'd guess emphasizing the "philosophy in life" as much as in science. :-)

Slow down. Read a cheap paperback. Learn to cook.

(As if ... I think I'm willing to string along with my wife's Disney World addiction as the only way to get me off my PC-enabled information addiction.)

5:26) 05-FEB-2003 15:46 Nicholas Carroll

<harkening back a couple of posts...>

Feynman was always worth listening to. Francis Bacon made a comment in *Novum Organum*, 1620, that specifically address the "will to self-delusion":

"The human understanding, once it has adopted opinions, either because they were already accepted and believed, or because it likes them, draws everything else to support and agree with them. And though it may meet a greater number and weight of contrary instances, it will, with great and harmful prejudice, ignore or condemn or exclude them by introducing some distinction, in order that the authority of those earlier assumptions may remain intact and unharmed.

"So it was a good answer made by that man who, on being shown a picture hanging in a temple of those who, having taken their vows, had escaped shipwreck, was asked whether he did not now recognise the power of the gods. He asked in turn: "But where are the pictures of those who perished after taking their vows?" The same reasoning can be seen in every superstition, whether in astrology, dreams, omens, nemesis and the like, in which men find such vanities pleasing, and take note of events where they are fulfilled, but where they are not (even if this happens much more often), they disregard them and pass them by. But this evil lurks far more insidiously in philosophies and sciences, in which an opinion once adopted infects and brings under control all the rest, though the latter may be much firmer and better.

"Moreover, even without this pleasure and vanity I have spoken of, the human understanding still has this peculiar and perpetual fault of being more moved and excited by affirmatives than by negatives, whereas rightly and properly it ought to give equal weight to both; rather, in fact, in every truly constituted axiom, a negative instance has the greater weight."

This was a disease I encountered continually in the dot-bomb; my efforts to examine negative data were seen as "pessimism" -- when in fact I was trying to clear out the superstitions, and develop a foundation of reality from which to advance. (And I did, to my own benefit -- but it didn't help my clients who insisted on optimism as a cure-all.)

5:27) 05-FEB-2003 15:57 Nicholas Carroll

Still thinking on Feynman: I went over that ground some years ago, and but for the lack of a few billion in funding, would have been interested in a grand study of how humans really acquire their information and mis-information. That is, start with Babylon, and trace the transmission of beliefs through all the formal and informal means of communication, to determine how the average human acquires their odd set of beliefs.

There is a temptation to treat the human clay as a *tabula rasa*, and assume that by creating authority figures, by repeating the same message over and over, or by formal schooling, we can determine an individual's beliefs. Yet for all that people still exist on believing or disbelieving in UFOs, when the proper answer is, "How in the devil would **I** know?"

□ 5:28) 05-FEB-2003 16:16 Brian Solheim

It seems to me that the various technologies identified in the reports will evolve on their own, regardless of what we do as a country. Canada does not have the resources to do everything, so as others have said, we need to narrow our focus and choose specific things. At the Geostrategics workshop in Ottawa, virtually every breakout team talked about needing to extract "knowledge" from the information that is and will be available using the new technologies. Building a "Knowledge System" that is useful is a very complex problem and involves several of the disruptive technologies already identified. I am not an expert on this, however, developing ways to distill the ever growing volume of data/information into something that is understandable and can be used to make informed decisions would be a niche that we could focus on. Canada could become a knowledge broker. This could provide far reaching social and economic benefits for Canada.

□ 5:29) 05-FEB-2003 16:20 John Verdon

I am struck again, by the lack of attention given to social technologies. In *The Tipping Point* the author makes a point of the magic number of 150 (or around that number) as the optimal size of an effective and aligned community. Groups that get larger than about 150 undergo a significant transformation. Bruce Sterling in his recent *Tomorrow Now* discusses, Shamil Basaev, Zeljko Raznatovic, and Abdullah Catli under his section on "the soldier" and a new twist on unconventional warfare. For example, the effective use of cell phones and cheap motorola walkie talkies to coordinate a "swaggering condottieri, of murderous, prickly, triggerhappy and eager to avenge any slight" terrorists. This is disruptive social technology - techniques for organizing people to achieve ends. Our industrial organizations are like orchestras, with each employee required to perform a highly conscribed set of tasks. Sterling is talking about "jazz". Social jazz, organizing people loosely, with broad intentions, serving self and self's group. More dependent on improvisation and thus less predictable to others.

Technology is not only disruptive of entrenched technologies but of organizing principles. To leverage technologies in productive and positive ways, a great deal of thought has to be applied to culture and social structure barriers and enablers.

I foresee, that many of the mobile sensor technologies can transform health care in a way allows for the first time a truly preventative approach. The doctor (medical service) is contracted to monitor all my information (the food I eat and when, the exercise I get and when, the activities I undertake, the places I visit, the environmental factors I'm exposed to) and when something anomolous appears to the service's analysts (human and artificial), the doctor (and whatever other partnered assistance) contacts me for a visit, or prescriptive action. Results of my following through become apparent and so on...

How will this change the education of doctors, heath professionals, my work, governance, insurance. When it becomes clear the some communities, buildings, etc. are less healthy than others, what can one do? What will be expected from government? etc.

The psychological impact of relationships as apparent on physical health should be much more evident, traceable. How can these be mediated, transformed, prescribed for? Should the psychological impact of managers be included in their compensation, performance review, span of control? Will chemistry of teams become a measurable determinant of organizational inclusion, boundary?

I'm not sure if my first comment and following example completely hang together, but I hope they are stimulating.

5:30) 05-FEB-2003 17:00 Ahmed Shalabi

John, I like your comment on "... disruptive social technology - techniques for organizing people to achieve end". This is true. I think it was Shaw who coined: " A fool's brain digests philosophy into folly, science into superstition, and art into pedantry."

Here's another article to provoke.

Think before you talk

Jan 16th 2003

From The Economist print edition

Can technology make mobile phones less socially disruptive?

THE mobile phone is a paradoxical device. Its primary function is social: to enable its owner to communicate with other people. At the same time, though, using a mobile phone can seem profoundly anti-social, not least to people in the immediate vicinity. In restaurants, theatres and museums, on trains, or even standing in the supermarket checkout queue, there is no escape from chirping and bleeping phones, nor from the inane conversations of their owners. Last year Philip Reed, a New York councillor, proposed a law that would prohibit the use of mobile phones in "places of public performance", such as theatres, art galleries and concert halls, punishable by a \$50 fine. But his proposal has been derided as unenforceable. Might a technological approach to taming the mobile phone, and the behaviour of its users, be more successful?

Crispin Jones, Graham Pullin and their colleagues at Ideo, an industrial-design company, think the answer is yes. (Ideo is responsible for designing such products as the Palm V pocket computer, the original Microsoft mouse, the TiVo personal video-recorder and the world's most high-tech dressing rooms, at Prada in New York.) As part of an internal research project, the team designed five prototype "social mobiles" which modify their users' behaviour to make it less disruptive.

For example, the first phone, called SoMo1, gives its user a mild electric shock, depending on how loudly the person at the other end is speaking. This encourages both parties to speak more quietly, otherwise the mild tingling becomes an unpleasant jolt. Such phones, the designers suggest archly,

could be given to repeat offenders who persistently disturb people with intrusive phone conversations.

SoMo2 is a phone intended for use in situations (such as a hushed art gallery) where speaking is inappropriate. Manipulating a joystick and a pair of saxophone keys controls a speech synthesiser that produces an expressive range of vowel sounds for non-verbal communication: "Hmm? Yeah." The third phone, SoMo3, resembles a small, clarinet-like musical instrument. Dialling is done by holding down combinations of keys and blowing; tunes replace phone numbers. "The public performance that dialling demands acts as a litmus test of when it is appropriate to make a call," say the designers.

SoMo4 replaces ringtones with a knocking sound: to make a call, select the number and knock on the back of the phone, as you would on somebody's door. The recipient of the call hears this knock (cleverly encoded and relayed via a short text-message) and decides how urgent the call is. How you knock on a door, says Mr Pullin, is freighted with meaning: there is a world of difference between tentative tapping and insistent hammering. SoMo5 has a catapult-like device that can be used to trigger intrusive sounds on a nearby user's phone, anonymously alerting them that they are speaking too loudly.

None of these phones is intended as a commercial product; the design team simply hopes to provoke discussion. It seems to be working. The project has just won a prize from the Agency of Cultural Affairs in Japan, perhaps the country where both social etiquette and mobile phones are taken more seriously than anywhere else. And behind these silly-sounding phones is a serious point. Much is made of "user-centric" design, says Mr Pullin, but in the case of mobile phones, the people surrounding the user need to be considered too.

Copyright © 2003 The Economist Newspaper and The Economist Group.

5:31) 05-FEB-2003 17:07 Jim W. Lai

Perhaps it's useful to consider exactly what is being transformed or disrupted more explicitly. Is it an individual's life? The coherence of a social organization? The operational flows of information and action?

Jazz. Unity of intention, rather than unity of command. Network structures, rather than hierarchical command and control.

Regarding the phones: A person with a high tolerance for pain could "grief" the recipient of a shockphone by deliberately talking loudly and accepting any pain back. They may be a minority, but on a mass scale such will emerge. Alternately, call someone up, scream, then hang up before they have a chance to retaliate. Quaint notion, but easily abused.

5:32) 05-FEB-2003 17:32 Ahmed Shalabi

You're right Jim. This article below by Professor Meadows brings us full-circle, in that a 'point' in the future is unpredictable.

<http://www.wholeearth.com/ArticleBin/447.html>

5:33) 05-FEB-2003 17:43 Howard Rheingold

John, it sounds like you might not be aware of my recent book that ought to interest you, since it is about the disruptive potential of mobile communication, pervasive computing, and collective action:

<http://www.smartmobs.com>

5:34) 05-FEB-2003 18:31 John Verdon

Ahmed, Jim, Howard,

Thanks for the comment. I like unity of intention.

The phones? Well phones have always been damned as interfering even as the function for our convenience. New technologies come without developed eticade. Their socially responsive usage is left to trial and error and of course ultimate use is so often unforeseeable. The mobile is presaging a new public/private interface and will ultimate get resolved. I remeber as a young man I spend time in Spain and became aware of how every one talked when they where on the bus. I could hardly wait to get back to Ottawa so I could understand what people talked about on the bus. When I got to Ottawa, no-one talked? Alot of this public habit is cultural.

The invasion of private space is only begining. Perhaps we will be developing subvocalization software to replace voice recognition software and will be able to mediate the public space - private dialogue more easily.

Howard, I was not aware of your book, but will look it up. Bruce Sterling in one of his recent science fictions presented the notion of smart mob terrorism and net mediated anonymous coordination. The capacity coordinate sequentially and in parallel, over local and vastly distributed areas actions seems like an inevitable reaction to increasing trend for surveillance of the public sphere. I look forward to reading your work.

5:35) 05-FEB-2003 18:54 Nicholas Carroll

"... the notion of smart mob terrorism and net mediated anonymous coordination ..."

I predicted that in a paper in 1986, with the Phillipines as the location.

So, it could have made me look like a genius -- as long as I didn't publish any of my other predictions!

5:36) 06-FEB-2003 01:10 John Verdon

lol, :)

5:37) 06-FEB-2003 06:38 Dirk Flinthart

It seems to me on consideration that each new technology contains the potential to be seriously disruptive. In these reports, we have happily considered advanced medical sciences -- cures and enhancements, technologies to prolong life.

Okay.

Well, here in Australia there is already talk of raising the retirement age, and encouraging people to work until their mid-seventies. The social security scheme which provides for the elderly is already stressed, and will become more so as the boomers grey out. Combine that with advanced technologies prolonging life, and you are immediately confronted with a powerful disruptive effect.

The effect becomes even greater if you consider the ecological and political implications of a population leading active lives until perhaps a hundred and twenty years of age. Are we going to provide for the upskilling and re-education of people whose basic social orientations formed eight decades ago? If not, are we going to allow them the same social decision-making franchise as people who are educated and oriented to a world radically different from that which existed only three decades ago?

Then there are the long-term sneakers -- the disruptive effects of new technologies which don't appear for decades. An example of such is the effect on global warming which results from increased atmospheric CO2 released by the burning of fossil fuels... the same burning which transformed the world in previous decades. Ironically, a technology which currently appears highly disruptive -- genetic manipulation -- may eventually provide desperately needed remedial answers to the disruptive legacies of previously transformative technologies.

If it were up to me, I would pick a couple of the technological advancements which are generally agreed upon as being very likely to come about, and I'd get a bunch of writers and game-designers and artists to play with whatever ideas emerge. Then I'd take their concepts and hand them back to the researchers and scientists for consideration. That way, you're likely to get both sides of the story.

5:38) 06-FEB-2003 10:27 Adam L. Gruen

Dirk, that is a splendid idea. I shall have to start something just like that. If only I could get a grant for it.

5:39) 06-FEB-2003 11:41 Scott Mackenzie

The disruptive phenomenon is still pretty much a puzzle. Clayton Christensen (HBS) and others have done some excellent work on retrospective disruption; but the predictive capability remains very cloudy.

Christensen has outlined attributes for disruptive technologies/innovation. Among these are:

A change in business model (or mission model)
Competition based on new performance metrics
Incubation in fringe or "different" markets

For Canada to make a difference in the disruptive process, it seems reasonable to ask: "What are our fringe markets?", "What markets do we excel in?"

Perhaps the answer is related to cold weather, wide open spaces and trying to communicate or travel from here to there.

If we understand where disruptions might incubate and ask the business model and performance metrics questions, perhaps we can get closer to understanding potential Canadian disruptions.

5:40) 06-FEB-2003 12:16 Ahmed Shalabi

Scott spotted in **The New York Review of Books**, Volume L, Number 2 · February 13, 2003

The eighteenth century was "the golden age of the philosophical toy," and its most celebrated engineer was Jacques de Vaucanson. For Vaucanson, recreating life meant imitating its processes and movements—most famously, its bowel movements. While he entertained audiences with automata that played the flute and the organ, his most celebrated invention was a copper duck that realistically "gulped" food through a flexible neck and then excreted it on a silver platter. First displayed in 1739, the duck caused a sensation. "Without the shitting duck," Voltaire quipped, "there would be nothing to remind us of the glory of France."

5:41) 06-FEB-2003 14:06 Nicholas Carroll

HA!

5:42) 06-FEB-2003 14:20 Nicholas Carroll

"For Canada to make a difference in the disruptive process, it seems reasonable to ask: "What are our fringe markets?", "What markets do we excel in?"

"Perhaps the answer is related to cold weather, wide open spaces and trying to communicate or travel from here to there."

In the US the Web has already created a significant disruption in commerce. Below the radar of the media, as they prognosticate about bricks-and-mortar businesses supplanting dot-coms, and the meaning of eBay, rural America is selling their wares online, utterly ignoring what goes on in San Francisco or New York City. On Main St. a hundred meters away from me, the pawnbroker and the cleaning supply company and the graphic artist and the candy shop are together moving several million dollars a year over the Web. Likewise, with the nearest bookstore 100k distant, the residents are buying information on line.

There is the temptation to dismiss rural populations as yokels, but in when I sold books via Globe and the Financial Post ads before the Web, my customers were not in Toronto; they were in Yellow Knife and Saskatoon and upper Manitoba. (But never, ever in Timmins.) Yes, a Globe reader in Yellow Knife is the intelligensia of that town -- but when the most successful farmer in the area suddenly learns how to turn his pond into a trout farm, people notice, and some emulate.

5:43) 06-FEB-2003 14:25 Adam L. Gruen

I would be careful of attaching too much importance to being "disruptive" and "transformative". I interview dozens of small businessmen every year and about half of them claim these attractive buzzwords for their new products and services. They are not typically in the 10% that survive.

There is plenty of profit to be made, jobs to be created, lives to be made better and safer and happier, and in general (if I may be so bold as to use the word)"progress" to be furthered by developing plain old vanilla incremental improvements.

To give one example. LEDs replacing lightbulbs. I don't know that LEDs are particularly either disruptive or transformative. But figure out a way how to make them as inexpensively as lightbulbs, and you have changed the dynamics of the electric utility industry permanently. Is that transformative enough?

5:44) 06-FEB-2003 14:41 Robert Crosby

Heh. Reminds me of Dean Kamen's Segway scooter. The advance hype predicted it would be greatly transformative. If recent legislation passed in San Francisco is any indication, it may not even be disruptive.

5:45) 06-FEB-2003 14:53 Jim W. Lai

Incremental is fine if one does not face international competition. This is part of the rationale behind transformation, to leapfrog competitors and seize new markets earlier (or in the case of the military, increase asymmetric advantage).

Expanding on Adam's point, novel biotech catalysis and synthesis may enable new (or make cost-effective known) production technologies which are cheaper and/or cleaner. This will be harder to anticipate.

<http://www.wired.com/news/technology/0,1282,57428,00.html>

5:46) 06-FEB-2003 14:59 Bob Watson

One issue I have with "Transformative and Disruptive Technologies" is the assumption that "tech" involves either "science" or "machinery." It can also mean a new way of doing things w/o much, if any, change in the tools at hand.

Our culture is very dependent upon academia and professionalism (academics grant degrees that professionals use as "union cards"). Change that relationship -- say by setting performance standards via some type of testing -- and society will be very disrupted and transformed w/o a change in "tech" as the word is generally used.

5:47) 06-FEB-2003 15:14 Jim W. Lai

In IT we've got skillset-specific certification programs offered by vendors. Academia wasn't fast enough to offer similar deals, and it gives the vendors more control with regard to which technologies they wanted to allow to be certified (e.g. Microsoft's forced obsolescence).

Open source is a potentially disruptive method of organizing production (descended from the academic model).

Is IT pointing to new ways of doing things?

5:48) 06-FEB-2003 15:17 Bob Watson

Maybe so, Jim. Maybe so.

5:49) 06-FEB-2003 17:54 Nicholas Carroll

"One issue I have with "Transformative and Disruptive Technologies" is the assumption that "tech" involves either "science" or "machinery." It can also mean a new way of doing things w/o much, if any, change in the tools at hand."

Right on, Bob. Christiansen's(sp?) book was mostly about how state-of-the-market machines gradually improved, and slowly cut into other companies' economic niches -- not overnight miracles. His book now seems to have been embraced by the "It's gotta be ten times better!" crowd. (Adam's non-survivors?)

Shucks, look at what put Honda motorcycles on the map -- the Beach Boys singing "Little Honda." And dirt biking was off and running.

5:50) 06-FEB-2003 18:07 Jim W. Lai

Japanese motorcycle manufacturers did a hybrid strategy. During they 80s they produced a large number of models. Many incremental improvements in rapid succession as opposed to leapfrogging. Speed counts. Japanese auto manufacturers got inside the loop of American manufacturers, having a shorter design-to-road cycle. I also got the sense of this from my encounter with their domestic consumer electronics, walkmans specifically, in 1991 during a visit to Japan.

The notion of leapfrogging may come from a Western analytical bias towards seeking out a single point of control (take out the top of a command pyramid) rather than focusing on fast process. Pushing for leapfrog technologies solely is an indication that there's no confidence in the ability to shorten design cycles.

5:51) 06-FEB-2003 18:16 Nicholas Carroll

Yeah, but according to Christiansen's book, in the '60s they pursued a "Christ, try anything!" strategy. ;-)

5:52) 06-FEB-2003 18:21 Jim W. Lai

Sometimes successful strategies emerge over time, rather than being planned with foresight. Touche.

5:53) 06-FEB-2003 18:32 Nicholas Carroll

Aye. I recall the moment when I put up my first website (in a vague thought that maybe it would make money somehow, someday), and someone asked me what the purpose of the site was. I calmly told them, "I have no idea."

Today that site makes money, and the people with the visionary websites are gone. It was a situation where I simply didn't have enough data to formulate a plan. In time patterns emerged, and I found myself following the Chinese adage: "Wait long, then move fast."

5:54) 06-FEB-2003 18:44 Howard Rheingold

This might have potential for transformation/disruption:

THE POWER OF DISTRIBUTED POWER

From the plains of Africa to the carports of this country, UC Berkeley professor Daniel Kammen is putting the power to generate renewable forms of energy into the hands of the people. The idea behind the distributed power systems Kammen researches is to equip individuals, businesses, or neighborhoods with the technology to produce their own electricity instead of buying it from centralized power plants. They might even make money doing it.

Full story and photos: <http://www.coe.berkeley.edu/labnotes/0103/kammen.html>

5:55) 06-FEB-2003 21:39 Nicholas Carroll

It's inevitable -- and the dictators aren't going like the consequences. As someone smarter than me once observed, "Energy revolutions always breed social revolutions."

Kammen observes, "If production is closer to where electricity is used, we'll waste less electricity during transmission." Yup. Electricity 101. Plus the grid is damnably expensive to build in the first place, as are phone grids.

By the mid-1980 I'd pretty well concluded that the LDCs would go without the grid for both electricity and voice communication. The question remains: when electricity was more vital than communication, why has alternative energy lagged so far behind cellular deployment?

Part of the answer is that cell phones cost less than solar panels. Also only G-7 nations could produce the panels at reasonable cost, and since the G-7 said the hell with alternative energy, the prices took a long time to fall to LDC affordability. I think the consequences of alternative energy production are going to shock the bejesus out of LDC and G-7 governments alike.

Perhaps Canada might want to take a look at what is being done in the LDCs? Necessity is, after all, the mother of invention. Kamman has a pretty big lab out there.

5:56) 07-FEB-2003 07:59 Dirk Flinthart

Actually, this is almost precisely the first thing that came to mind when I suggested brainstorming around a single technical advance. The question was: what would high-density (of energy storage) low-cost hydrogen fuel cells lead to?

My first thought was that the person who went on to design an interchangeable cell that could power a fridge, a TV, a sewing machine, or a car (perhaps in lots of four or five!) would change the way we thought about power distribution. Couple such a storage and delivery system with something like a small solar cell, or the kind of wind generator you find on boats, and you have a big step towards living independently of commercially generated electricity... for a lot of people.

5:57) 07-FEB-2003 09:42 Jim W. Lai

Less dependence on the grid would enhance power survivability in the case of ice storms which take down power lines, or terrorist infrastructure attack. Less chance of Enron-style energy arbitrage. Maybe power companies could go into the fuel cell delivery business? Grids may still be effective in cities, like public transportation.

Oh, identifying potential public utilities or commons arising from new tech sounds like a useful approach too.

5:58) 07-FEB-2003 14:18 Nicholas Carroll

An interchangeable fuel cell would be *wildly* disruptive. Farmers would "get it" almost instantly.

Grids are still effective in cities because they're already amortized. But in a mild glacial age, Canada might have to "go underground" like the Edmonton Mall. In such a climatic scenario I wonder if surface grids would stay up and running. If the choice were between building a new underground grid and localized alternative energy, I imagine the financials would favour AE.

I don't know about power companies going into the fuel cell delivery business. In fact they look like a future chapter in "The Innovator's Dilemma" -- they see the prospects of alternative energy clearly, but their mindset condemns them to see it as a threat rather than an opportunity. Ah, the handicaps of ethical corruption.

On the whole, I see alternative energy as critical to Canada's economic security.

5:59) 07-FEB-2003 14:56 Adam L. Gruen

I think that's right. And, elsewhere, I have recently been arguing that while *generating* off-grid power is nifty and wonderful and much appreciated -- especially if it can be done with minimal pollution -- that figuring out a reasonably efficient way to *store* it reversably is the real breakthrough. So that people can buy cheap and sell high, so to speak.

This would especially be useful for Canada, which, along with whatever other attributes it may possess, does have 1) large surface area and 2) northern latitude.

5:60) 07-FEB-2003 17:18 Nicholas Carroll

I've wondered why energy storage so often focuses on chemical methods (along with occasional mechanical schemes like compressed air tanks). What's wrong with "gravity storage"? Elevate x mass to x height, and you've stored energy. Of course I'm not a mechanical engineer. How much mass does one have to elevate to what height to power a typical house for a day?

I'm minded of Big Island on Hawaii, where the water pressure arrives at your house at several hundred psi. Plenty you can do with that sort of energy.

(Valves reduce it to 40 psi before it enters the house.)

5:61) 07-FEB-2003 18:34 Dirk Flinthart

Nicholas: an interchangeable fuel cell would indeed be wildly disruptive -- but when you think about the way batteries are used interchangeably without a second thought, I would suspect that such a fuel cell would be a highly likely development. Makes it worth consideration, I believe.

And wildly disruptive, yes -- but think about how desirable it would be from a consumer viewpoint! This is one of the reasons why I think it's a likely development.

I agree with the development of alternative energy as a critical, by the way. Not just for Canada: for everybody. With America positioning itself to maintain it's oil-driven hegemony by acquiring Iraq's reserves, we are clearly being shown that the plan for the future is a kind of "every man for himself" at an international level.

Any country dependent on petrochemical reserves for energy is not a country which can seriously plan a 25 year research programme. Scientific research calls for a high level of infrastructure -- which demands petrochemical energy, and will continue to do so until something else is provided.

5:62) 07-FEB-2003 18:52 Phil Staal

Pumped Storage Hydro: From a back-of-the envelope calculation, assuming a typical house uses 40 kWh/day, if the water is raised to the height of about two stories (6 m), and for a regeneration efficiency of 80%, you would need to raise about 3000 tons of water (volume roughly equivalent to the size of the house).

5:63) 07-FEB-2003 19:41 Robert Crosby

Most of the ideas being floated here fail in terms of 2nd law of thermodynamics. [Here](#) is a good energy fundamentals primer to give some perspective.

5:64) 07-FEB-2003 22:10 Nicholas Carroll

Nice paper. A friend once asked me if (to avoid the landlord's surcharge) he could put an airconditioner in his closed instead or the window. Mulling it, I told him, "Give it a try. If it works, I'll write the paper, and we can share the Nobel prize."

Ergo, Phil, it could only work in hill country, where the homeowner had the land to raise 5 tons of water to much greater heights. Which excludes virtually all the well-populated areas of Canada. Onwards....

5:65) 07-FEB-2003 22:47 Adam L. Gruen

Robert, I was thinking of you specifically when I wrote, "reasonably efficient" method of storing electricity. I'm not asking for the impossible, the improbable, or even the difficult. I'm suggesting that we need *some* technology that offers Joe Average (or, in Quebec, Jacques Average) a fighting chance to stay off the grid. Permanently.

5:66) 07-FEB-2003 23:05 Phil Staal

I should have specified that my note on "Pumped Storage Hydro" was simply an answer to a previous question, and not an endorsement of the approach. Certainly pumped storage is used in numerous large central installations, but as Nicholas noted, individual homeowner use is problematic, except perhaps a few places like parts of North Vancouver. One could of course dig a well with a large cavern at the bottom instead of going up...

5:67) 07-FEB-2003 23:25 Nicholas Carroll

Admittedly I've only skimmed the PDF Robert posted ... but in rural California, people *are* off the grid -- permanently. One can power a house, including heat, with USD 12,000 in panels, inverters, and batteries. (One ostentatious neighbor is producing 800 amps with \$14,000 in equipment. Or perhaps he's a pot grower.) With monthly gas/electric bills running above \$200, that amortizes pretty fast.* I'll go back to the paper later, but if endusers are saving money, and manufacturers are saving money, it's hard to see how the environment is being depleted faster.

Yes, Phil. And certainly safer than perching tons of water above your house...

* Actually in the case of three of my neighbors, amortization took zero days, because the power utility demanded \$50,000 to run power out to them.

5:68) 08-FEB-2003 01:24 Robert Crosby

"Ergo, Phil, it could only work in hill country, where the homeowner had the land to raise 5 tons of water to much greater heights."

Actually, it couldn't work at all, since the energy to pump it to the top of the hill would greatly exceed the energy that could be extracted from letting it fall back down. Unless you use the hydrologic cycle to do the pumping for you, that is. Which is already done, at places like the Hoover Dam, etc.

[er. you were kidding, right, Nicholas?]

5:69) 08-FEB-2003 08:17 Phil Staal

Nicholas' original question was in part "...wondered why energy storage so often focuses on chemical methods..." Pumping water up to a reservoir is used very effectively in a number of large operations, with energy storage efficiency up to roughly 80%. However, at first blush it doesn't seem very practical for individual home owners. The key factors of energy density and life cycle cost have probably driven the use of chemical energy storage. Converting energy from one form to another should be avoided if possible to avoid losses. Thus storing heat in cheap large masses is effective for home heating, and storing electric power in an electrochemical form is attractive for providing electric power.

In a somewhat related vein, there is a significant shift to eliminating drive trains and hydraulics and switching to electric power distribution for navy ships (also for electric cars). This provides more flexibility in equipment arrangement and redundancy, as well as allowing large amounts of energy to be sent to specific devices. I suppose it's a bit like the change a century ago from factories and mills that used axles and belts to distribute power to those using individual electric motors.

5:70) 08-FEB-2003 12:34 Robert Crosby

"Pumping water up to a reservoir is used very effectively in a number of large operations, with energy storage efficiency up to roughly 80%."

I don't know how you are defining efficiency. KWH in vs KWH out? 80% efficiency sounds reasonable for the turbine, converting kinetic energy to electricity. But you also need to include pump efficiency and head losses (friction) in the piping system. As a whole system, I doesn't seem likely that you could get more than about half that. But I'm willing to be proven wrong. :-)

"Converting energy from one form to another should be avoided if possible to avoid losses."

How? Do you know of any storage technologies that can avoid that?

5:71) 08-FEB-2003 13:03 Phil Staal

Take a look at http://www.electricitystorage.org/tech/technologies_technologies.htm and in particular at the pumped hydro storage item. I've seen many articles quoting various efficiencies -- I chose 80% just for rough calculation, but it seems to be reasonable.

What I meant was for example if you want to store solar energy for later use to heat a house, it's probably most efficient to store it as heat in a mass rather than for example to collect the solar energy with solar cells, store the electricity, then use the electricity in an electric heater later. Conversely, if you want to run a computer from solar energy, using solar cells and storing the energy in an electrochemical form is probably better than trying to convert stored heat into electricity.

5:72) 08-FEB-2003 13:06 Nicholas Carroll

Robert, I'm aware of the energy needed to elevate the mass. However I was presuming "free" alternative energy to do the pumping.

"In a somewhat related vein, there is a significant shift to eliminating drive trains ..."

Amen. My old Porsche picked up quite a bit of free horsepower by the elimination of the driveshaft used in conventional front engine/rear drive cars.

5:73) 08-FEB-2003 13:10 Jim W. Lai

Storage always presumes there's a more abundant energy source which requires distribution (across space and/or time) to be useful.

5:74) 08-FEB-2003 13:14 Nicholas Carroll

"What I meant was for example if you want to store solar energy for later use to heat a house, it's probably most efficient to store it as heat in a mass rather than for example to collect the solar energy with solar cells ..."

Yep. Mexicans figured that out a few hundred years ago with the thick-walled adobe house. In much of California houses barely need air-conditioning or heating -- just mass. In hippie days I had friends who did a passable imitation by lining the sunny side of their house with black 55 gallon drums of water, and then building a moving wall around it. Come night they would slide closed the outer wall, and open the inner wall.

5:75) 08-FEB-2003 13:18 Nicholas Carroll

Most true, Jim. In California -- or on the Laurentide plateau -- wind power still strikes me as viable. There was a post somewhere here about the miniscule portion of electricity provided by wind in California. I can offer an economic reason for that: most of the towers were built for tax write-off schemes, not profitability. Today, as I drive through the coast range, there are areas where a full 90% of the windmills are broken down.

5:76) 08-FEB-2003 14:25 Robert Crosby

Ah, I get it. The 80% is the *storage* efficiency only. I was thinking in terms of overall process efficiency.

Getting back to transformative and disruptive technologies, I can think of no more transformative change to make, than to overhaul the educational system to include [systems dynamics](#) as a mandatory subject all through K-12. Democracy cannot work with an uneducated populace, and we have one that, with the exception of a small elite '[priesthood](#)', is utterly ignorant of such ways of thinking.

I like to imagine a society in which our leaders and policy makers (not to mention teachers, lawyers, doctors, scientists, et al) are selected from a general population who have learned to *think*, as the children who built [these models](#) are learning, rather than to just absorb facts, while being told that that is thinking.

More resources:

<http://www.sevastopol.k12.wi.us/socialstudies/sysdyn.html>

<http://www.facingthefuture.org/>

5:77) 10-FEB-2003 10:15 Bob Watson

IMO, that's a very good point, Robert. "Connection" is ubiquitous. It's the ability to stand alone that's rare. Even, perhaps especially, school kids can appreciate this -- it's easy to model and easy to demonstrate through things as simple as a terrarium.

But is there room in the curriculum? I dunno about in Canada, but my own 3rd grader has to learn his multiplication tables at home (via Internet exercises) because the teacher has no time to drill -- no one wants to take responsibility for deciding what is most important. I think "thinking about systems" is critically important, even as I own doubts about folks actually knowing everything that's important about a given natural system.

One might note that the "educational system" is also a technology (with a process and a division of labor) for inculcating particular POVs in people (starting with kids). Altering *that* technology may be more transformative than any mechanical invention.

5:78) 10-FEB-2003 12:02 Robert Crosby

Yes. Exactly. I can think of no more important or (positively) transformative technology. In [Item 8:28](#) I posted an excerpt from a piece by Donella Meadows about the first 10 years of computerized global modeling. After describing the wild and contentious disparity between different models and modelers, she came up with a list of things that all (surprisingly) found themselves agreeing to. Number one on the list was:

1. There is no known physical or technical reason why basic needs cannot be supplied for all the world's people into the foreseeable future. These needs are not being met now because of social and political structures, values, norms and world views, not because of physical scarcities."

Much as I enjoy speculative science and science fiction about amazing new technologies, if this is a valid statement, I don't see how any of them (that do not address these underlying structural issues) will be able to do any more than just throw new wild cards into the mix. With unknown (and unknowable) consequences.

[minor edits]

5:79) 11-FEB-2003 09:33 Bryan Alexander

Systems thinking, with a global, forward-looking stance, could color a curriculum as a theme, allowing teachers and students to bring in instances and modules as needed.

5:80) 11-FEB-2003 12:31 Charles Cameron

I note that Moore's Law is listed at #3 at the head of this item -- regarding which there is some trenchant comment today in "Forget Moore's Law" on **Roland Piquepaille's Technology Trends:**

<http://www.redherring.com/insider/2003/02/moore021003.html>

It all boils down to the question, *who really needs twice as more computing power every eighteen months?* Apparently Google doesn't think *they* do.

5:81) 11-FEB-2003 12:39 Jim W. Lai

I suspect Google's tasks are often limited by bandwidth. There are several factors beyond mere CPU speed which go into overall computing performance, whether it be a desktop PC or a networked cluster. A computer is a system, not merely a CPU. And at the scale Google is looking at, the latest CPUs probably have a poor cost/performance ratio. I've personally found it more cost effective to buy last year's screamer rather than the bleeding edge. Say as a guesstimate the cost might be half as much as the latest system, with two-thirds of the performance. Since upgrades are ongoing, one should look to commoditization of older technologies as also enabling new processes.

5:82) 11-FEB-2003 13:05 Robert Crosby

re the impact of Moore's Law:

My current computer runs at a clock speed over 2,000 times faster than my first PC, has about 8,000 times more RAM, and over a million times more disk storage capacity. Yet I am really no more productive with it than I was with that first Osborne (though the documents I produce now do *look* a lot prettier).

The main effect of Moore's Law on me has been to induce a more or less permanent state of future shock. I hardly have time to learn the machine to the point that it is "in my fingers", before it changes, and I am forced to relearn it. Over and over. The possible upside is that I suppose I've learned to become more adaptable. A species of deutero-learning, perhaps?

5:83) 11-FEB-2003 14:31 Nicholas Carroll

I would say I'm **less** productive than I was on DOS or Win 3.11. Feature bloat has made it pointless to gain mastery of any MS applications. The continual enforced upgrades mean I no longer bother to write macros for any particular application. The impossibility of cleanly exporting text from Word to a DTP program means I tend to write in ASCII. The near-impossibility of exporting spreadsheet data cleanly from Excel means I no longer bother to write complex spreadsheets. The huge difficulty of recovering text from corrupted Word files means I store text files in ASCII. The massive and irreparable system corruption that builds up over a year in Win 98 means I no longer bother to customize my desktop. I'm just waiting for something else....

Nrc Foresight Workshop Item 5

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Nrc Technology Foresight Workshop Item 6

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Message from your Host

Item 6 04-FEB-2003 07:01 Moya K. Mason

There are over 100 people registered for this workshop/conference. Some of you have made your presence known. Thank you very much! I know that not all are familiar nor all that comfortable with this mode for meeting and talking. I understand that and just hope it won't hold anyone back from adding to the conversation. Please feel free to email me for a walk through. I can even talk to you on the phone. I would love to help make this a very successful gathering of minds, so don't hesitate to ask.

I know it's different but this sort of software will be used more and more in the future, and it really is a great way to brainstorm any subject because you can read at your leisure and make thoughtful comments based on your background. **Everyone has something important to say and we really would like to hear it.**

Many of you were present for the face-to-face meetings that made these reports possible and have added so much already. Perhaps you could bring forward some of what you contributed at the meetings so that we can discuss it in this venue. Maybe you would like to talk about how your department plans to use scenario planning as a way to see into the future. I am sure some of you have worked in the government or in specialized industries long enough to have insight into how scenarios have helped in the past to create the future that we are already living. That can also act as a great jumping off point.

It is not very often that we have access to such industrious people as all of you and we really want to hear what you have to say and dream of and imagine.

Some of the organizers, including Jack Smith, who heads up the Office of Technology Foresight, are on the road but will hopefully be able to drop in today or tomorrow.

Thanks again to everyone.

6:1) 04-FEB-2003 10:38 Burl Grey

Just to note that I'm here and working hard.

I invoke the aphorism: I wrote a long letter for lack of time to compose a short one :-)

6:2) 04-FEB-2003 12:10 Jack Smith

Hello to all of you who have joined us for this initial web conference on the NRC S&T foresight pilot project. My name is Jack Smith and I have been asking myself for months the kinds of questions we are posing in the Conference. They may not be the best questions but at least they introduce us to the contingencies of the future with a focus on how these broad areas of capability - geo and bio are beginning to stratch our concepts of disciplines, domains and fields. So I welcome all of your thoughts about these emergent forces and insights and how they may shape our understanding of what are often weak signalled alignments of future significance.

6:3) 04-FEB-2003 14:12 Adam L. Gruen

Thank you, Moya and Jack, for having us as your guests.

6:4) 04-FEB-2003 15:28 Moya K. Mason

Thanks so much for coming, Adam!

6:5) 06-FEB-2003 14:55 Moya K. Mason

Due to a number of requests to keep the conference open for a longer period of time so that those who are having a heavy week can contribute/contribute more, we are extending it until end of the day Monday, February 10th.

I am going to be sending an email announcing this, so I apologize in advance for the duplication of information to those who read this message here first.

Thanks to Howard for giving us the place to talk.

6:6) 06-FEB-2003 17:20 Charles Cameron

I'm very appreciative of this change in schedule, Moya: I've been stimulated by a number of threads here and in the two reports, and have a number of posts I'd like to make, but my schedule has been taxing these last days.

I'd also like to ask whether it would be possible to have a CD-ROM burned of the conference as a whole, and mailed to interested participants (as at OSN2001)? It would be helpful to be able to mull over the discussions at a later date. Alternatively, will the conference still be available to registered participants for some time to come?

6:7) 06-FEB-2003 17:55 Nicholas Carroll

Ditto. There are some posts I'd like to mull over later on.

6:8) 07-FEB-2003 08:48 Moya K. Mason

Yes, I've heard on email from others who are very thankful that the schedule is changed.

Charles, we haven't yet gotten to the stage of archival discussion, so I will let you know when I do.

Thanks again to everyone for their high quality discussions.

6:9) 07-FEB-2003 11:07 Howard Rheingold

Yes, it is possible to burn a CD-ROM of the conference, but will require spending some extra money to get the person who maintains Caucus to run the program that does that. Moya, you can contact Toby about that.

6:10) 07-FEB-2003 13:43 Moya K. Mason

Thanks to an idea that Dirk had, we are going to be creating a couple of interesting items later today. I will have the content later this afternoon and will post it then.

6:11) 07-FEB-2003 18:36 Dirk Flinthart

Oooh, goody!

6:12) 09-FEB-2003 20:24 Moya K. Mason

For the remaining 30 hours or so of the conference, I encourage you to create new items for topics you think we should discuss. It is very easy to do this. You'll notice this set of navigation on the main page:

You may **create a new item**, read **all the items**, or click on item titles listed below to read individual items.

Just click on **create a new item** to see how easy it is to do.

6:13) 10-FEB-2003 15:48 Jack Smith

As we are nearing the end of the extended designated time for this Conference, I wish to express my appreciation and respect for the incredible number of thoughtful and original ideas that have been contributed - over 400 postings I believe during the past week. The NRC and its ten federal partners thank you for assisting us in moving the imagination and critical thinking about these two technology areas forward, and for the extensive wisdom and stimulating prompts you have all provided.

This has been a very useful learning experience for our pilot project, and one that we may try to replicate and extend if our resources and schedule permit toward the end of March - a decision we would hope to be able to take by the end of February. You can be sure that everyone who registered for this initial Conference will be notified of any subsequent one.

By that time we will have had an opportunity to reflect upon the ideas offered, and to develop further some challenging scenarios for the future of the technologies we have been examining. We are currently discussing several scenarios that would capture many of the points made during the Conference and which could present images of several kinds of societal needs and problems that may be created or addressed by these technologies as they continue to evolve over the next decade and beyond.

Thank you all again for your contributions to this forum.

6:14) 10-FEB-2003 18:11 Moya K. Mason

I also would like to thank everyone for taking time out of such busy schedules to contribute over the last number of days. You really are the best of the best and I am proud to know you.

Thanks to Jack Smith, Ray Bouchard, and Peter Kallai for making this possible and for all their work behind the scenes.

Special thanks to Grace Twain from Memphis for creating all the usernames and passwords, and for her patience!

As always, a special thanks to Howard for his hospitality.

I have arranged with Grace to leave this space open until tomorrow morning, so feel free to have fun tonight.

I will be contacting those people to receive a copy of *Smart Mobs: The Next Social Revolution* by email. It will be almost impossible to choose only six of you but since I know some of you already have the book, my work will be a little easier.

Thank you very much!

6:15) 10-FEB-2003 21:11 Nicholas Carroll

Thanks to both of you. Good show!

6:16) 11-FEB-2003 09:33 Bryan Alexander

Very good reading and thinking. Thank you, all!

Nrc Technology Foresight Workshop Item 6

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Nrc Technology Foresight Workshop Item 7

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

BioSystemics: Introduction of Principal Observations

Item 7 04-FEB-2003 11:55 Moya K. Mason

This is a short overview of BioSystemics and the principal observations from the BioSystemics report. What I'm going to do is take the expanded sections on the observations and create separate categories to make it easier for people to discuss them. They will be taken directly from the report.

BioSystemics:

The convergence of nanotechnology, ecological science, biotechnology, information technology and cognitive sciences, and their prospective impacts on materials science, the management of public systems for bio-health, eco and food system integrity and disease mitigation.

The BioSystemics component of the STFPF focused on the following question:

How can the Federal Government - via FINE (Federal Innovation Networks of Excellence) departments and agencies, better understand the complexities and interdependencies of Canada's food, health and environmental systems, and develop a 10+ year horizon of actionable intelligence for research policy in these areas, given new knowledge about emergence, behavior of populations, disease ecology, genomics, etc.?

Principal Observations

There appears to be a "slipstream" of scientific discovery and technological progress that is directing and giving energy to new discoveries. It can be described in terms of 6 components.

1. **The IT juggernaut.** Amazingly, the progress of computer technology has not slowed down since the 50s. Indeed it shows signs of continuing at a more furious pace. The digitization and virtualization of the world has extended our ability to communicate, visualize and control beyond any natural human ability.
2. **Biotechnology.** Our expanding ability to study cell, organisms, and their relation to their environment continues to bring success in an area of great complexity. This new

understanding of self-organizing, self-replicating objects is creating knowledge in the unrelated areas of IT and nanotechnology. We have created the potential to engineer life forms, something that touches on the very meaning of existence.

3. **Nanotechnology.** We are on the threshold of building structures at the atomic and molecular level, structures that we cannot see, feel or smell. Yet these structures can have amazingly useful properties. It is expected that this field will enable us to devise instruments of exceptional sensitivity which will greatly expand our ability to view and understand the biological world.
4. **Medical Science** will be revolutionized by these new technologies through the use of non-invasive monitoring techniques, highly directed drugs, and much more effective prosthetics.
5. **Cognitive Sciences.** The ability to understand neural functions may well have profound effects on human performance and well being. There will likely be a cross-fertilization with the IT sector as we train computers to think like humans.
6. **Systems Science.** An understanding of fundamental material process, combined with new mathematical work in the area of chaos theory, cellular automata, small world networks, and game theory will likely enable us to understand and better manage a wide range of complex systems.

7:1) 04-FEB-2003 18:43 Dirk Flinthart

Post-humanism time, in other words. Anybody here read "The Spike", by Australian science-fiction writer and futurist Damien Broderick?

7:2) 04-FEB-2003 22:24 Jim W. Lai

No, but posthuman capability with iron and steam age ideologies immediately suggests scenarios that could range from ideological utopias to godswar among posthuman factions.

7:3) 05-FEB-2003 08:11 Dirk Flinthart

Yeh. To me, that's almost an inevitable -- and incredibly spooky -- outcome. You lift human capacities to an incredible degree, but leave the same old bullshit in charge, and you get something indescribably dangerous and dumb.

7:4) 05-FEB-2003 09:14 Jack Smith

The matching of human capabilities in terms of ecological and sustainable management of carrying capacity and the increasing power of technology - do we further alter the development-preservation and evolutionary balance toward tipping points, or do we apply our hopefully greater knowledge, more effective measurement and feedback tools and more general awareness of effects toward bioremediation and other mitigating solutions - we expect that our scenarios should posit both boundary conditions - where do you think we should strike a balance given that the 20th century apparently pushed us much further down the negative pathway?

7:5) 05-FEB-2003 11:43 Robert Crosby

Of the 6 Principal Observations listed, I don't see them all as belonging to the same category, or logical level. Specifically, I view "Systems Science" (#6) as a different (and more useful) approach to understanding the other 5.

7:6) 05-FEB-2003 12:29 Charles Cameron

Which brings us to the extraordinary importance of Donella Meadows' classic, *Places to Intervene in a System*:

<http://www.sustainalaska.org/WholeEarthRev.pdf>

For those who don't know it, this unassuming-looking but brilliant piece offers an extraordinary countdown from least-effective to most-effective intervention points. It is striking how genuine *vision* (ie the ability to re-envision one's paradigm) turns out to be a key component in the most successful intervention.

7:7) 05-FEB-2003 13:13 Jim W. Lai

This ties into Sun Tzu's notion that a key to waging war is to attack the opponent's strategy.

That said, Goedel's Incompleteness Theorem also implies that paradigms themselves come with built-in logical traps. One way out is to juggle axioms, shift paradigms. Axioms could be considered coordinate systems within which to frame issues. On a meta level this is not entirely unlike a problem solving technique in mathematics of transforming a difficult problem from one domain to that of an equivalent problem in another domain which is tractable.

7:8) 05-FEB-2003 16:17 Nicholas Carroll

To Jack's: "where do you think we should strike a balance given that the 20th century apparently pushed us much further down the negative pathway?"

Personally, I'd rather err on the side of caution ... slowing the March of Folly to the crawl of folly. There are not a whole lot of problems I can't solve for myself -- except for death, and other people. (Sartre, "Hell is other people.")

That's easy enough to say living in a wealthy country, but it equally applies to nations that are starving because their latest dictator has pushed agricultural production towards luxury items like coffee so he can afford another Rolls-Royce.

7:9) 06-FEB-2003 10:10 Norm Willis

In comment on item 4, I think it is important to consider that medical treatment will give way to generic immune enhancement or disease prevention based on the technological advances currently underway. Specific vaccines are limiting and only effective with single strain organisms. Therefore the approach of medicine will be pushed in a totally different direction, and the needs of this should be the drive of research after the focus on infectious disease has been satisfied.

This will similarly apply to food production particularly animal protein production but not exclusively. However of equal importance is the development of technology that will allow the distribution of food throughout the world to where people are starving.

Finally I feel that it is essential that multidisciplinary research include the social sciences since as is mentioned in some of the previous comments technology gains can be neutralized if society can not effectively use them.

I realize that we don't live in utopia but to maximize the return on this research, these factors should at least influence the decisions and directions.

7:10) 06-FEB-2003 10:18 Bob Watson
(slipped Norm)

Heh. There's a saying -- if you push anything hard enough, it **will** fall over.

In our "western" capitalistic culture we provide opportunities by making certain things profitable. Sometimes, this is on purpose (industrial incentives, for instance). Sometimes not (as in the US "war on drugs") -- a great demonstration of the power of capitalism, if you're a drug lord.

One way of looking at the role of government is to align the incentives so that certain things (the environment, for example) are not pushed so hard that they do fall over. It's a heck of a lot easier than trying to pick things up again.

7:11) 06-FEB-2003 14:56 Peggy Tsang

I wonder if the development of biosystemics can take some lessons from information technology - the development of open-source products, versus the pure business drive which could end up with one (or a few) big winner(s).

7:12) 06-FEB-2003 15:21 Jim W. Lai

Open standards which promote interoperability can also be useful. For example, ebXML is authored and pushed by OASIS (<http://www.oasis-open.org/who/>) and the UN. The goal is to provide a common framework for automatic business transactions. While the initial drive will be for large organizations, the development of turnkey solutions will enable small and medium size enterprises to enter into the supply chain/web more effectively (and thus boost GDP). Are there common data format initiatives which could boost effectiveness in the biosystemics field?

The high-level notion here is to reduce friction (or barriers to entry and participation).

Nrc Technology Foresight Workshop Item 7

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Nrc Technology Foresight Workshop Item 8

[Home](#)Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

BioSystemics: Biotechnology Observations

 Item 8 04-FEB-2003 11:59 Moya K. Mason

These are the Biotechnology Observations. Comments? Criticisms? What would you add?

For the purposes of this study, we adopted a broad definition of biotechnology. The term encompasses the sciences, technologies, organizations and regulatory groups that have as their goal the understanding, alteration, and functional modification of organic cells - including plants, animals and humans. It also includes the possible work on non-cellular life forms (e.g. viruses) at which point biotechnology overlaps with nanotechnology.

As these early technologies lead us in to the foresight time frame (2015 - 2025), we can see the emergence of some key technology drivers.

- Capability to specifically build genetic sequences and proteins.
- High level of capability to monitor and measure phenomena at the molecular level and in remote or hostile environments.
- Ability to substitute industrial processes with sustainable agricultural processes.
- Much higher understanding of the specific causes and specific remedies for a wide number of illnesses. There will be a much improved predictive capability for "at risk" individuals.

 8:1) 04-FEB-2003 12:23 Bob Watson

Might want to add "ability to grow organs"

 8:2) 04-FEB-2003 14:38 Jim W. Lai

Organ and tissue cosmetic replacement and/or enhancement. Cultured drug synthesis and delivery organs could be implanted, e.g. built-in caffeine or amphetamine rush, or pancreas replacement for diabetics. Combined with molecular sensors and other means of neurochemical measurement, automatic self-treatment of mental conditions could be possible. Earlier detection may lead to call for preemptive mental care.

8:3) 04-FEB-2003 18:51 Dirk Flinthart

I am repeatedly startled by ideas that somehow we're going to be able to encompass, predictively and datawise, major ecosystems to the point where we will know what's happening before it happens, and will be able to use genotech to repair, remediate, and rebuild.

I don't mean to be negative, but I'm reasonably sure that no matter how groovy our computational powers get, there are limits imposed by what we know of chaos theory. By way of example:

Back when I was a pup studying ecological modelling at college, my prof talked about a very simple study done on an unusually simple ecosystem. There was a spring-fed pond. There was a tree that dropped leaves into the pond. There were a couple species of fish and crustacean that nibbled the fallen leaves and each other.

The goal of the study was to predict population levels of the fish. They figured that since they could quantify *all* the input to the pond, and monitor levels of reproduction, etc, they'd have a decent chance of developing a predictive population model. The idea was that the techniques could then be upscaled for larger or more complex systems.

It was a fiasco. They were happy when their line of prediction was positive or negative at the same time as the population was growing or falling... and that didn't happen very often. In fact, by the end of it, they concluded they'd have done better just *guessing*.

As I understand it, very small perturbations in the beginning state of any complex system lead to essentially unpredictable end-states. I am, therefore, extremely wary of predictions that say we will be able to understand fully, to direct, repair and control ecological systems which have been in place for hundreds of thousands of years, with a level of complexity in terms of simple numbers of species that even now we do not know.

8:4) 04-FEB-2003 21:57 Nicholas Carroll

Heh. I share your doubts when it comes to "managing an ecosystem". That would take more than knowledge; it would take wisdom.

I recall some of my psych profs -- Skinnerian types -- constructing a cage divided by wire mesh, and putting snakes in one half and rats in the other, so that they could (who knows how?) measure the rats' fear levels. The next morn they returned to find the wire mesh torn, the snakes gone, and the rats plump.

8:5) 05-FEB-2003 08:16 Dirk Flinthart

Indeed. In fact, it seems to me that a great deal of this extrapolation has failed to take into account quantum uncertainties, and the inbuilt uncertainty provided for by established chaos theory. Does anybody know why this is so? Have I missed something in the two reports? Is there some research afoot which is designed to thwart Heisenberg and still the butterfly-wings of chaos? If not, then many of the extrapolations here with regard to massive simulations of realtime environments are simply wishful thinking, and much of the hype surrounding nanotech is exactly that: hype.

These people have done a lot more research and study than I have. Ergo, I have to conclude it is likely I missed something. Anybody out there able to tell me what it was?

8:6) 05-FEB-2003 09:23 Jack Smith

I agree that the linking of our notions of 20th century management norms (mostly command and control, plus some more strategic use of anticipatory and feedback, knowledge management derived tools) to ecological systems may present significant hurdles for biosystemic technological development - management motivations tend to seek stability, routine and operational predictability - attributes that may not be what we seek in robust biosystemic technologies of the future - where in complexity terms we will want dynamic multisensor determined contingencies and multilayered systems that can cascade problem signals until the most effective adjustment mechanisms can be tested without necessarily being managed.

8:7) 05-FEB-2003 12:37 Robert Crosby

Even beyond that, I would say that it requires a fundamental rethinking of the relationship between ourselves and the ecosystems of which we are a part. The idea of 'command and control' of nature betrays a misunderstanding of that relationship, which, IMO, dooms the attempt to failure.

8:8) 05-FEB-2003 12:42 Bob Watson

Nicely said, Robert. The "control" part we sometimes do pretty well, but the "command" part is forever beyond our reach.

Of course, that is also part of our concept of "ownership" inasmuch as one can -- in law -- command what one owns. It is indeed problematic.

8:9) 05-FEB-2003 12:43 William Doubleday

RE 8.3

The two main reports seem to come from a Cartesian, Newtonistic world view. i.e. With more data, more accurate data, more detailed data, accurate predictions will be possible far into the future.

In my experience in fisheries research and ocean science the opposite usually happens. Better observation reveals more complexity and shows that natural systems are less predictable than previously thought. Better diagnosis, but not necessarily better control.

The possibility of collecting much more observational data seems real enough to me, but the value added is not so evident. I can see how more extensive observation can fill in existing voids and allow assessments based on fact instead of assumptions, but I expect diminishing returns would set in before the "swarm" level of observation density.

Who is going to review all this data and act on it? I find the suggestion of automated or semiautomated decision making disturbing, along with the "1984" tendencies of ubiquitous surveillance. Government action in the context of natural resources and ecosystems tends to allow, restrict or forbid actions that corporations or private citizens want to take. I would expect any automated approach would be vigorously resisted by stakeholders.

The challenge of making sense of vast data flows for earth systems will be daunting. Perhaps this is one appropriate focus for government - managing the databases and assimilating the data.

Bill Doubleday

8:10) 05-FEB-2003 12:52 Charles Cameron

William writes:

The two main reports seem to come from a Cartesian, Newtonistic world view. i.e. With more data, more accurate data, more detailed data, accurate predictions will be possible far into the future.

In my experience in fisheries research and ocean science the opposite usually happens. Better observation reveals more complexity and shows that natural systems are less predictable than previously thought. Better diagnosis, but not necessarily better control.

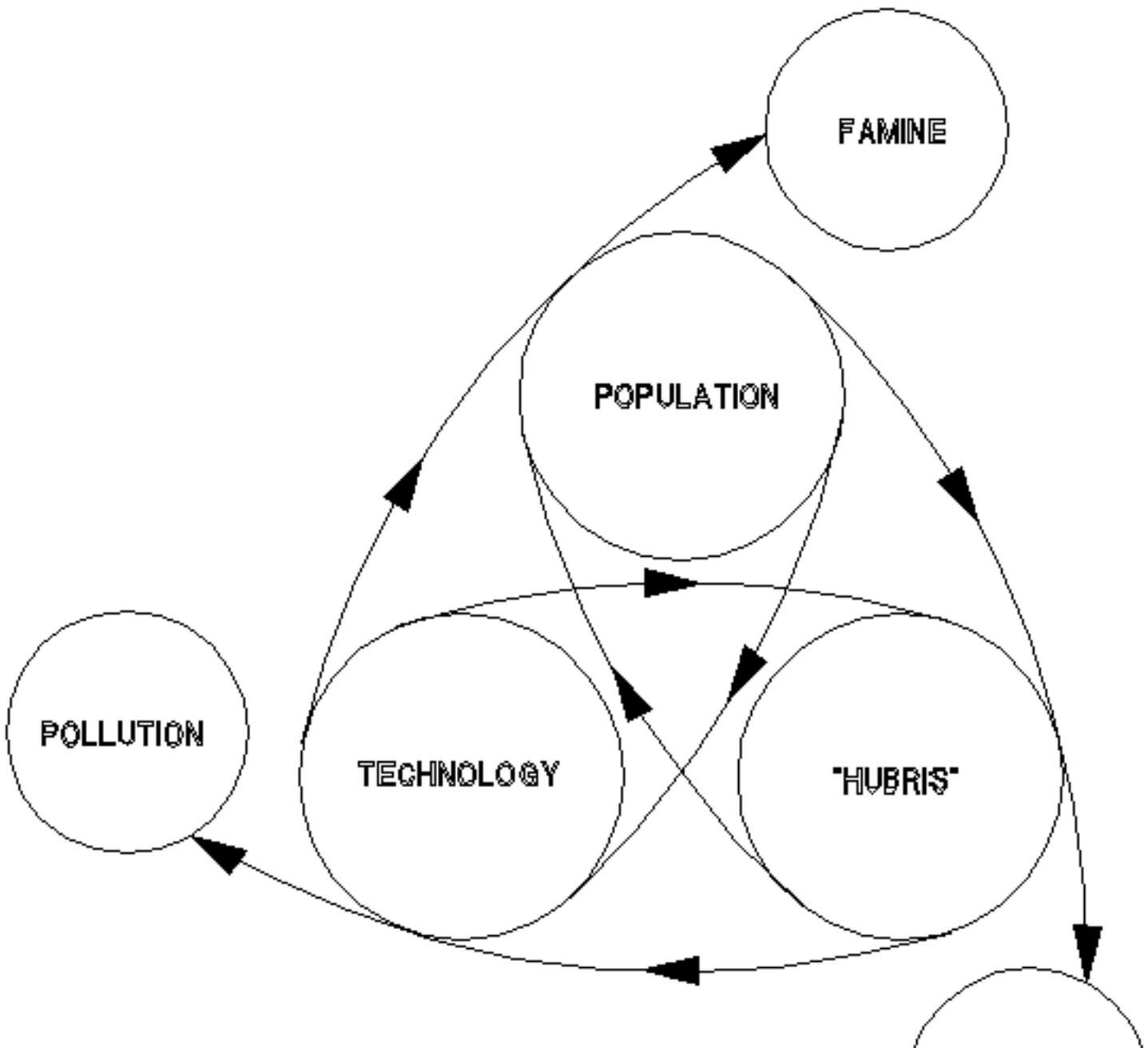
Point well taken, sir. This ties in with my mention of Donella Meadows' *Places to Intervene in a System* at [Item 7:6](#), and specifically with her observation that the most effective intervention points are those in which the paradigm itself is rethought.

□ **8:11) 05-FEB-2003 14:07 Robert Crosby**

And therein lies the problem, as that is one of the most difficult things any of us can do.

For example, consider the following diagram. It shows a set of dynamic relationships between population, technology and our deeply embedded beliefs about our relationship to the world we live in. The arrows all point in the same direction, indicating that each element feeds the other in a positive direction. In cybernetics, such self-feeding autocatalytic processes have the property of going into runaway and crashing.

Now this view may or may not be valid. Certainly it's not complete. But it illustrates a way of thinking based on a paradigm quite different from the currently dominant world view. Before one can begin to find places to intervene (introduce some negative feedback?) in this system, one must first share the paradigm on which it is based.





8:12) 05-FEB-2003 14:20 Charles Cameron

That's a somewhat polemical diagram, Robert.

8:13) 05-FEB-2003 15:32 Robert Crosby

True. (and maybe inappropriate for this topic? If so, feel free to ignore...)

It is from a Bateson essay [The Roots of Ecological Crisis](#), found in [Steps to an Ecology of Mind](#). He says about it:

"The bigger the population, the faster it grows; the more technology we have, the faster the rate of new invention; and the more we believe in our "power" over an enemy environment, the more "power" we seem to have and the more spiteful the environment seems to be. The increase in population spurs technological progress and creates that anxiety which sets us against our environment as an enemy; while technology both facilitates increase of population and reinforces our arrogance, or "hubris", vis-a-vis the natural environment."

He goes on to *optimistically* suggest that introduction of negative feedback into any one of the three elements can slow down the cycle. It seems to me that the "Hubris" element is the only realistic point of entry. This is not to suggest that we stop developing technology (as if we could), but that we begin to focus on technologies that don't just continue to feed the runaway processes.

8:14) 05-FEB-2003 15:37 Bob Watson

So education (among other things) may be important after all?

:~)

8:15) 05-FEB-2003 16:50 Nicholas Carroll

Better -- or even just more -- education certainly reduces the incidence of most types of individual violence. As my neighbor the criminologist told me: "Requiring 4 year college degrees to become a policeman in itself reduces incidence of police violence."

Doesn't seem to do much to reduce wars, though.

8:16) 05-FEB-2003 16:53 Jim W. Lai

Urbanization leads to a sub-replacement reproduction rate. That's one limiter not taken into account. Immigration has been the solution, but life extension allowing improved function as we age might reduce the need for such.

8:17) 05-FEB-2003 16:57 Nichole Dusyk

From Bill's comments:

"The challenge of making sense of vast data flows for earth systems will be daunting. Perhaps this is one appropriate focus for government - managing the databases and assimilating the data."

I would add that government has a role a step before that in determining useful and appropriate indicators and intervention points so that we can get beyond ubiquitous surveillance and collection of unreasonable amounts of data.

Amongst all this technological determinism, somehow we'll make choices about what is appropriate and necessary (as no amount of efficiency will counter limited resources)- I'd argue that it's best that those choices be made as explicitly as possible rather than just letting them happen by chance.

8:18) 05-FEB-2003 17:26 John Verdon

I like, Bateson's ideas about epistemological pathologies and our adiction to the fact that we have thus far been able to create necessary flexibilities, which of course we rapidly use up. We have entered the post-species ecology, however, and we are not about to slow progress down or put the brakes on. We do have to change our management paradigm.

The notion of "man's dominion over nature" rooted in our judeo-christian theology, is comfortable with the industrial organization and the maestro of the classical orchestra. We still assume the ability to ochestra our own interventions. However, an ochestra depends on tightly circumscribed roles, an iron script and faithful reproduction. The human (post-human) in the post-species ecology will likely have to be a jazz musician, constantly improvising, recovering errors and dead-ends with riffs that align with melodic affinity of the original tune, but that also contribute to a sustainable flow of unpredictable contributions from other players.

It is my understanding that this is not much different from the workings of natural evolution. The key difference is the speed. The human and the post-human can be seen like any other cataclismic event - oxygen producing bacteria changing the atmosphere and making a context for a whole world of new beings, meteorites that change weather and set in motion extinctions and ultimate new beings. Humans are transforming their context/environment one question is what life forms are next? Perhaps, forward is the only direction to go for metamorphosis into a new ecology.

8:19) 05-FEB-2003 20:49 Robert Crosby

Well said, John.

I just recently finished reading Barabasi's [Linked](#). Scale-free networks are ubiquitous in nature (from spread of epidemics, to molecular structure of living cells, to nervous systems, to the internet, to the power grid, to terrorist networks...) No one designed these networks. They arise on their own, spontaneously, as an emergent property of the collective action of the participants pursuing their own self-interest.

How do these networks arise? By what mechanism? Barabasi has little to say about that, but I think that as the science matures, the answers to those questions may finally start to supplant the dominant world view that *we* are in control of "nature", something alien to, and outside of ourselves.

I find it interesting to note that there are cultures who have no word for, nor concept of, "nature", having never distinguished it as something different from themselves. Perhaps the most profound transformation to come from these emerging sciences will be the re-cognition of such a world view. Given the extent of the industrial and financial commitment to technologies based on, e.g., biology's "central dogma", however, it won't be any time soon, or easy.

8:20) 06-FEB-2003 15:33 Erik Lockeberg

Re 8.3 and 8.5 from Dirk Flinthart (limitation of modeling by Heisenberg and chaos).

An interesting paper:

Model Error in Weather Forecasting: Does Chaos Matter?

by David Orrell, Mathematics Institute, University of Oxford, UK email: orrell@maths.ox.ac.uk

This paper asserts that poor weather forecasts cannot be blamed on error due to chaos (sensitivity to initial conditions). The gist of the paper is the rate of increase of error grows as the square root of time. This indicates that the model is in error. An exponential growth of error would indicate the model is fundamentally OK, but is showing sensitivity to its input data.

Re 8.7, 8.8, 8.9, 8.10 where Robert Crosby, Bob Watson, Bill Doubleday and Charles Cameron doubt the feasibility of omniscient models, and question our ability to use them wisely.

I agree with these two points, but I also believe that data-gathering and modeling is indispensable for our future.

1. **Data Is Good.** Statistics collects all sorts of data on the Canadian population, where we live, where we work, what we earn, etc, etc. This data allows government to make better-informed decisions, and allows the people to know what the situation is, and what the trends are. One may still argue about decisions and policies, but at least the facts are there as a basis.

We take for granted that no discussion of social housing, say, is going to waste time with party A asserting that the population of Ottawa is 5 million, and party B saying, no, no, the population is only 300,000. On the other hand, debates about East coast cod stocks get hung up on arguments about how many cod there are.

2. Models Can Be Well-Behaved And Useful. Some models work very well. For example, the law of supply and demand predicts a price equilibrium, and if supply is reduced, the price will go up. In the right circumstances (many buyers, many sellers, full information, etc), the model works well. The used car market is such a case.

3. Models That Are Badly Behaved Are Still Useful. If we develop a model that seems like it should work, but delivers terrible predictions (as described in 8.3), then we should conclude that we do not understand what is going on. If we are conscious of a lack of knowledge, we will be less tempted to interfere. Even better, we will have an argument to use against the people who do want to interfere for their own selfish reasons. We can say to them, show us your model and prove that you understand the consequences before you act.

4. We Need To Know More About Models. I believe that models are like statistics: an indispensable tool when used properly, but often poorly understood and abused. Theoretical knowledge about modeling is, as far as I know, in a relatively rudimentary state. There is a great deal of work to do to understand what kinds of models there are, how to use them appropriately and how to quantify their fit to the modeled domain.

8:21) 06-FEB-2003 16:03 Jim W. Lai

Models are limited by logic. Goedel's Incompleteness Theorem concludes there exist truth statements which cannot be determined within a given set of axioms. Additional data gathering corresponds to going outside the existing axiom set by extending it.

The Black-Scholes options pricing model is an example of an unrealistic model (admittedly so, as they make quite a few assumptions!) which is still quite successful in practice.

I agree that models which demonstrate instability can act as a canary in a coalmine, and that further study is required before serious errors are made. Alternately, they may highlight existing problems.

We need to achieve better understanding of ecosystems as systems. (E.g. do we have a full assessment of stocks of predator and prey for cod?)

8:22) 06-FEB-2003 16:07 Burl Grey

Knowledge will NEVER replace respect for ecosystems.

8:23) 06-FEB-2003 16:16 Jim W. Lai

Perhaps not, but ignorance also fuels hubris. One must know the limits of one's knowledge to be wise.

8:24) 06-FEB-2003 16:58 John Verdon

Knowledge is what creates respect for ecosystems.

8:25) 06-FEB-2003 17:01 Howard Rheingold

I would think that Burl would be the first to say that respect based on knowledge is epistemologically sound, but respect based on anything else is superstition.

8:26) 06-FEB-2003 17:22 Robert Crosby

I think models cannot tell us what *will* work, but they can show us what *will not* work. But more importantly, the exercise of building and testing the model forces us to think about the problem critically and in greater depth than we would otherwise tend to do.

Models have limited utility as predictive tools, but have far more value as experiential teaching/learning tools -- certainly better than the traditional educational model of "input fact > regurgitate on test > forget".

8:27) 06-FEB-2003 17:34 John Verdon

Yes the process of learning is more valuable often than what is learnt. My limited experience with models is the tremendous thinking and learning that had to take place to built the model expanded what questions I wanted to pose. Often the question I wanted answered after the model was completed where much different than the ones I started with.

8:28) 06-FEB-2003 18:11 Robert Crosby

There is a difference between what (some) modelers think their models are good for, and what a generally systems-illiterate public thinks. The following is from an article in the Summer 1982 *CoEvolution Quarterly* by Donella Meadows. Here she is speaking about some early global computer models (from a paper presented at an education and environment conference in Budapest, 1980):

"...a modeler is severely limited in the amount of information that he or she can include, and each of these models contains only a fraction of what is known about the world. Most of them focus on economic factors, population, and agricultural production. Only two of the seven contain any mention of resources or the environment. None say anything about war, politics, new ideas, or natural disasters. Most assume either that technology does not change-or that it changes automatically, exponentially, and without cost, to allow more and more to be produced from less and less. Some of the models represent the world as a single unit, others divide it into 10 to 15 regions or as many as 106 separate nations. Some run into the future as far as the year 2100, others only to 1985. Several, especially the first ones, have been highly

controversial and some of the later models were made expressly to refute or improve upon earlier ones. I am introducing you to these models to make several basic points that are often misunderstood by a public that is either too easily awed or too easily cynical about computer technologies.

1. The models are highly diverse. They were made by people with different political and cultural persuasions and all are extremely biased, but in very different ways. There is no such thing as an "objective" socioeconomic model.
2. Simultaneously, the models are tremendously complicated in what they represent (detailed population age structures, multiple economic sectors, complex trade patterns, various income classes) and surprisingly simplistic in what they omit (armaments, capital age structures, nearly all values, motivations, social norms, political structures, the sources and sinks of most material flows).
3. No model is (or is claimed to be) a predictive tool. At best each one is a very explicit mathematical rendering of someone's view of the world, tied down as much as possible with statistical data, logically consistent and able to produce statements of this sort: "If all these assumptions are correct, complete, and extended into the future, then the logical consequences will be..."

To me these models are instructive not singly but as a set. Although they were made by people of different continents and ideologies, the nature of the exercise forced those people to a similar and not-very-ordinary viewing point. All were looking at the globe as a whole and at the relatively long-term implications of the interconnecting web of population, capital, and economic production that links all nations. All were immersed in the global statistics and had to construct a model that captured the global situation with fullness and consistency - every seller must have a buyer, every birth must eventually be matched by a death, once productive capital is in place it cannot shift its purpose from a tractor factory to a hospital. **Despite many differences in emphasis and detail, viewing the closed system somehow produced some basic findings that are common to every one of the models. The modelers themselves, who generally started out hostile and critical of one another, have been surprised at the extent to which their conclusions overlapped.** The following statements would be agreed upon, I believe, by everyone involved in global modeling so far:

1. There is no known physical or technical reason why basic needs cannot be supplied for all the world's people into the foreseeable future. These needs are not being met now because of social and political structures, values, norms and world views, not because of physical scarcities.
2. Population and physical (material) capital cannot grow forever on a finite planet.
3. There is, quite simply, no reliable and complete information about the degree to which the earth's physical environment can absorb and meet the needs of further growth in population, capital, and the things that this population will generate. There is a great deal of partial information, which optimists read optimistically and pessimists read pessimistically.

4. Continuing "business-as-usual" policies through the next few decades will not lead to a desirable future or even to meeting basic human needs. It will result in an increasing gap between the rich and the poor, problems with resource availability and environmental destruction, and worsening economic conditions.
5. Because of these difficulties, continuing current trends is not a likely future course. Over the next three decades the world socioeconomic system will be in a period of transition to some state that will be not only quantitatively but also qualitatively different from the present.
6. The exact nature of this future state, and whether it will be better or worse than the present, is not predetermined, but is a function of decisions and changes being made now.
7. Owing to the momentum inherent in the world's physical and social processes, policy changes made soon are likely to have more impact with less effort than the same set of changes made later. By the time a problem is obvious to everyone, it is often too late to solve it.
8. Although technical changes are expected and needed, no set of purely technical changes tested in any of the models was sufficient in itself to bring about a desirable future. Restructuring social, economic, and political systems was much more effective.
9. The interdependencies among peoples and nations across time and space are greater than commonly imagined. Actions taken at one time and on one part of the globe have far-reaching consequences that are impossible to predict intuitively, and probably impossible to predict (totally, precisely, maybe at all) with computer models.
10. Because of these interdependencies, single, simple measures intended to reach narrowly defined goals are likely to be counterproductive. Decisions should be made within the broadest possible context, across space, time and areas of knowledge.
11. Cooperative approaches to achieving individual or national goals often turn out to be more beneficial in the long run to all parties than competitive approaches.
12. Many plans, programs, and agreements, particularly complex international ones, are based on assumptions about the world that are either mutually inconsistent or inconsistent with physical reality. Much time and effort is spent designing and debating policies that are, in fact, simply impossible.

To nearly anyone with the education and time to think about the world as a whole, these statements are not surprising. We all have an intuitive feel for how the complex systems in which we are embedded work, and the statements above are about the working of a complex system. Many of them follow directly from general systems theory. They were bound to emerge from any systematic look at the global economy.

What is surprising is the lack of congruence between these descriptions of the world and the view of the world reflected in policy - nearly every policy of every nation, enterprise, and individual. Those policies are virtually all based on such implicit assumptions as:

- There is not enough of anything to go around.

- We know that any physical or environmental limits are far away and can be ignored.
- Competition works better than cooperation; if everyone looks out for her or himself, the result will be satisfactory.
- Any change in policy should be postponed as long as possible.
- The future will be very much like the past, only bigger and better.
- The poor will catch up with the rich someday if we pursue business as usual.

The bottom line message of the global models is quite simple: *The world is a complex, interconnected finite, ecological-social-psychological-economic system. We treat it as if it were not, as if it were divisible, separable, simple, and infinite. Our persistent, intractable, global problems arise directly from this mismatch.* No one wants or works to generate hunger, poverty, pollution, or the elimination of species. Very few people favor arms races or terrorism or alcoholism or inflation. Yet those results are consistently produced by the system-as-a-whole, despite many policies and much effort directed against them. Many social policies work; they solve problems permanently. But some problems consistently resist solution in many cultures and over long periods of time. Those are the problems for which a new way of looking is required."

[emphases mine]

See: [Groping in the Dark : The First Decade of Global Modelling](#) by Donella Meadows.
(unfortunately, out of print)

8:29) 06-FEB-2003 18:20 Nicholas Carroll

But ... that's common sense. How does the woman get any respect from eggheads?

"7. Owing to the momentum inherent in the world's physical and social processes, policy changes made soon are likely to have more impact with less effort than the same set of changes made later. By the time a problem is obvious to everyone, it is often too late to solve it."

Marcus Aurelius made almost the identical observation, and the Romans (in a much simpler world) were certainly masters at aggressively solving problems before they got out of hand.

8:30) 06-FEB-2003 21:40 Hassan Masum

It's hard to even start thinking rationally about what's coming down the pipeline without good mental tools. Here's a start at a short set of pithy computational axioms:

- **"The Future belongs to those who can do multivariable statistics."** Most researchers still use good ol' x vs y plots, or at most xy vs z. Real situations have (at least) hundreds of relevant measures which need to be aggregated and correlated.
- **"Pessimize, don't optimize."** When uncertainty in a system becomes high enough, optimizing is irrational, since the system has high probability of rendering your carefully computed optimum irrelevant through prediction error or random shocks. Your best hope is actively avoiding the worst-case regions of future potentiality. (The term "pessimize" was introduced by yours truly in his recently-completed Ph.D. thesis - .)
- **"Ontologies help."** Search engines are good, but guided ontologies - categorizations of knowledge - are better for guided exploration. Librarians have been generating them for centuries, and they help. Shouldn't each organization and government have a simple, ongoing "ontology of future possibilities" - in say the form of a Yahoo!-style directory? Of course, ontologies change with increased understanding or changing points of view - but at least taxonomizing possibilities helps to decompose the problem space.
- **"High dimensionality can be a blessing."** The "curse of dimensionality" is well-known - high-dimensionality systems get exponentially difficult to compute / store / optimize / etc. What's not so well-known is that there is a complementary "blessing of dimensionality" - computing solutions to many real-world problems using a high-dimensional nonlinear representation (properly-designed neural net, GA, etc) can be unreasonably effective, partly because the high dimensionality itself seems to allow for many satisficing solutions to be easily found. Not always, but often. (Gershenfeld mentions it briefly in his "When Things Start to Think" - another recommended section in that book is the chapter on "Smart Money".)

8:31) 06-FEB-2003 21:42 Raymond Bouchard

I agree with Erik that that 'failed' models can be useful. For about 18 months I made a living trading stocks (don't ask why I stopped). Day after day I watched price movements and developed some decent notions about how prices would move over a 24 hour period. But once I had a hunch, I would model it and test it against data - namely if an equity matched my mental model within a certain time window, would it make money in a subsequent time window.

I would throw the computer at masses of data and more often than not discover that my new trading rule did not work out that well. What I was doing was modelling my intuition and testing against reality, which was more cost effective than going with intuition and trading (remember this is real money).

In this case I was not trying to model the world. I was modelling my assumptions.

8:32) 06-FEB-2003 22:13 Burl Grey

A small exercise -slight thrash- about a difficulty I have with even simple things in a forum like this **and** with those for whom I have great respect.

I was intensely frustrated by how things went from around 8:21

Jim, I'm using your post for my example because I'm in almost total agreement with you so far as I can see.

There had been talk about models, their characteristics and limitations... and in

8:21 Jim mentioned Godel's incompleteness and stuff. Then he wrote eloquently about things like the utility of some models. Going on to say *"We need to achieve better understanding of ecosystems as systems."*

Now I'm in total agreement with all that!

Then I posted this comment believing it supportive and a clear indictment of hubris

16:07 Where I said *"Knowledge will NEVER replace respect for ecosystems."*

Then Jim said *"Perhaps not, but ignorance also fuels hubris. One must know the limits of one's knowledge to be wise."*

His use of the word 'perhaps' where I think it's very close to absolute.. (that we will never know everything about an ecosystem) and then using the word "but" (ignorance also fuels hubris) which has the 'feel' of dissent about the idea... seems to be a kind of reservation from the very point I thought was agreed to... That *was* the very point I thought I was making!

That's not too bad, because it tends to reinforce my point... but then in

8:24 John said *"Knowledge is what creates respect for ecosystems."*

Unless that statement is interpreted carefully and perhaps ironically it's almost the reverse of the the meaning I sought! And I suspect encouraged by Jim's language.

The evidence for that conclusion is Howard's comment in

8:25 *"I would think that Burl would be the first to say that respect based on knowledge is epistemologically sound, but respect based on anything else is superstition."*

So my conclusion is that subtle differences as in Jim's wording... with the 'feel' of dissent or reservations becomes problematic -generates confusion- in those posts following.

My rationale for writing this is to suggest the order of communicational difficulty when the distinctions are more subtle, greater in number and complexity than this fairly simple and transparent example. Of course better writing skills could help my cause :-)

8:33) 06-FEB-2003 22:38 Raymond Bouchard

Burl may be pointing to a limitation of language itself. Over time, and with the right amount of socialization, we may come to a common understanding of what the colour "blue" is. There are a lot of blue things around and we can compare notes. Other things are not at all so clear. The word "aggressive" would be interpreted differently depending on culture - just look at what may pass for normal behaviour in New York City.

Now try words like knowledge, respect and ecosystems and you see the problem.

Language is the ultimate model, in which we (try to) abstract the entirety of the universe in a way understandable by all.

8:34) 06-FEB-2003 23:14 Jim W. Lai

Violent agreement? Perhaps I think more dialectically and thus desire to make explicit the background as a counterpoint to a foreground statement.

8:35) 07-FEB-2003 07:55 Raymond Bouchard

Thanks Grimjim.

I've always seen online conversations as a liquid. Their asynchronous aspect means there are many currents and they can get cooler or hotter. But they also have changes in phase. Godwin's Law is the low end phase at which the conversation degenerates to the point of non-movement. At the other end we get to the Zen phase in which we enter a new level of illumination.

We are now entering Zen-state in the context of the Bouchard theory of conversational phase shifting.

Nrc Technology Foresight Workshop Item 7

[Home](#)

Items: [1](#)|[2](#)|[3](#)|[4](#)|[5](#)|[6](#)|[7](#)|[8](#)|[9](#)|[10](#)|[11](#)|[12](#)|[13](#)|[14](#)|[15](#)|[16](#)

Nrc Technology Foresight Workshop Item 9

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

BioSystemics: Nanotechnology Observations

Item 9 04-FEB-2003 12:00 Moya K. Mason

These are the Nanotechnology Observations. Comments? Criticisms? What would you add?

Nanotechnology refers to research, technology development and eventually the production of products which used materials engineered at the atomic, molecular or macromolecular levels, in the length scale of approximately 1 - 100 nanometre range. Nanoscience refers to the fundamental understanding of phenomena and materials at the nanoscale. On a larger scale, nanotechnology research and development includes controlled manipulation nanoscale structures and their integration into larger material components, systems and architectures.

Within the foresight time frame (2015 - 2025), we can see the following key technology drivers.

- New structural materials with new design characteristics - notable impressive mass to strength ratios, but also electrical and memory properties
- Continuation of circuit density in semiconductors and bit density in storage devices.
- Emergence of nanosensors: to detect chemicals in the environment as well as in biological organisms; to detect mechanical properties (tension, torque, inertia, position, velocity) in robots.
- Integration of nanosensors with circuit logic
- Custom production of complex chemicals for use as pharmaceuticals and enzymes.

9:1) 04-FEB-2003 12:27 Bob Watson

I don't see a clear reference to "nanomachines" (I recall a proposal to build such a machine to clear arteries of plaque and there are certainly military purposes).

9:2) 04-FEB-2003 17:13 Louis Atkinson

Within the implementation of nanotech, I think that there will need to be suites of CAD tools with which to design them, perhaps with IDEs to program them.

9:3) 04-FEB-2003 18:56 Dirk Flinthart

I'll throw in two things here -- first, this link:

<http://www.wired.com/news/technology/0,1282,57536,00.html>

which discusses (as pop science, but well backed) the use of carbon nanotubes in the construction of a space elevator.

Secondly, this site: <http://smsc.snu.ac.kr/qtism02/abstracts/QT-04.html>

which refers to the observation of superconductivity in carbon nanotubes. Even if only as wildcards, both of these possibilities are definitely worth consideration -- seriously revolutionary potential.

9:4) 04-FEB-2003 19:48 Robert F. Johnston

Why not have nanotechnology extend the human brain. As in: integrate a supercomputer and communications into the brain itself. I think this will be done within the timeframe. I also think it will fundamentally change the way humans think and will give rise to a set of goals for 2050 that are literally unimaginable now. This was mentioned in the Biosystems section but not the unimaginable possible outcome.

9:5) 05-FEB-2003 08:20 Ole Peter Galaasen

At this point in time I think it's important to watch industries that apply nanotech in their production. I think this can be a good pre-cursor to where the first applications may come from. It's also interesting to see the balance between established industrial companies and their R&D efforts compared to up-starts and academia spin-offs. I think the R&D in big companies are more short term, while the start-ups is either long-term (4-10 years) or short-term and expect to be bought up by big companies.

[This website](#) has a category of companies that work with nanotech, have a look at them and see where it's heading.

9:6) 05-FEB-2003 08:22 Dirk Flinthart

Robert, you've bracketed the fundamental problem with 'Post-humanism' that science-fiction writers have been wrestling with for some time. Inevitably, if we augment human capacities to a degree now currently difficult to envisage, then we will also alter "human" thought and direction to a like degree. How, exactly, do you anticipate the behaviour of something you have no capacity to understand?

By way of example: there was a lovely Larry Niven story that talked about two advanced alien cultures. One culture studied religion very closely, with all the tools of science. One day, the entire culture committed suicide.

The other culture observed this, and concluded one of two possibilities: either that the afterlife was impossibly wonderful, or that it was terrible, and grew more and more terrible for each person in relation to the length of their lifespan. The second culture concluded that the first culture had established one of these ideas irrefutably through scientific research, which led to the mass extinction of the first culture.

The response of the second culture was to ban religion of any and all forms.

We're in the position of that second culture: having no way to anticipate what kind of discoveries might be made by a post-human culture, and no idea at all of how that culture might respond to those discoveries... but we're still trying to lay plans for it.

9:7) 05-FEB-2003 13:10 William Doubleday

RE Nano

Can we say anything about the status and trends of nanotechnology research and its application? Is it a question of private sector and US National Institutes of Health leadership or is it a multipolar situation? Nanotechnology does not seem to have quite the juggernaut momentum of IT at this point, but nevertheless has a lot of effort now and the beginnings of commercial products such as nanotube based tennis rackets and car fenders. If the touted benefits are real, we could see a huge investment of private funds over the next ten years and a flood of inventions.

Looking from the perspective of what priorities should be set for Canadian federal R&D, I think we need a sense of what the rest of the world is doing, how rapidly effort is accelerating and the extent to which we can share the results or build on them.

Should we be catalyzing some aspect of this area with public good potential but weak motivation of the private sector (i.e.?) or looking at how to apply what is developed by others for our purposes?

Bill Doubleday

9:8) 05-FEB-2003 13:25 Jim W. Lai

It's multipolar. China (in conjunction with Western private industry) is starting to put a lot of effort into nanotech research, no doubt in hopes of leapfrogging the West.

http://www.glocom.org/tech_reviews/et_report/20020610_s10/

There's quite a bit of effort and organization in Europe and Japan as well. It's probably likely to stay multipolar, as nanotech research is still so fundamental that there isn't a large barrier to entry for materials research. Materials would be the fastest to ramp up on.

This worldwide report is 3.5 years old:

<http://www.wtec.org/loyola/nano/>

The USA started up six nanotech centers in 2001.

<http://www.nsf.gov/home/crssprgm/nano/centers.htm>

9:9) 05-FEB-2003 13:34 Howard Rheingold

In conversation last night with someone knowledgeable about the field, he mentioned that the bio-nano and mecho-nano people aren't talking to each other. At all.

9:10) 05-FEB-2003 13:36 Bob Watson

And there lies an opportunity, I suppose, in medical technology.

9:11) 05-FEB-2003 16:21 Ole Peter Galaasen

I assume bio-nano and mecho-nano is other words for wet and dry nanotechnology. Strange to hear that these are becomming opposing "camps". I think the most progress is being done within "dry" nanotech, but also in medical imaging, which might be called "wet".

9:12) 05-FEB-2003 17:45 Howard Rheingold

It's because of the fragmentation of university research into disciplines. "Departments" rule. If you want to organize something across departments, you have to fund a "Center." Bioengineering is engineering in name only, and there is a huge cultural divide between people who mess with mitochondrial DNA and those who mess with microelectromechanical systems.

9:13) 06-FEB-2003 02:11 Bruce Damer

Just throwing in my two bits here:

Nanotech may be yet another oversold unrealizable technology like many other before it. Some evidence leaning this way is presented below.

Richard Smalley, who shared the Nobel for the discovery of Buckminsterfullerenes hit hard at the nanomanufacturing vision in a Scientific American article some months back. From my fuzzy memory his basic contention was that using "hand tool" or "industrial revolution" processes to make atoms go places and stay there is impossible at the nano scale where everything is driven by heat (brownian motion) and is wiggling furiously. Stuff cant be made to stick predictably. He cast all of this into the realm of science fiction dreaming.

Indeed Ralph Merkle's concepts for gears and cogs as well as Drexler's ideas of an assembler seem to fall into the category of "well, we are engineers and we say you can just do it and it will work" when in fact mother nature never fashions parts at the nanoscale as we do in megascale manufacturing.

George Whitehead at the 4th Foresight conference in 1995 said as much, basicly contending that in fact there will be no field of nanotech, only biology and materials science.

People seem to confuse micron-scale technology (Integrated Circuits, MEMS) with nanotech and assume we will just be able to photolith nano structures and get prectictable behavior.

I presented a demonstration software system at the 1995 Foresight conference:

<http://www.digitalspace.com/papers/nanopap1.html>

(very crude and I have to say the ideas are much more refined today).

The basic premise of my work at that time was that nanotech had to emulate biology very closely, through processes of controlled flows of reactive materials, chambered catalysis, deposition and chain reactions in a fluid. I did some informal speculation with colleagues at Chevron as they had identified a key application for nanotech: sensors that can tell them what fuel is present in a pipeline (type, grade). There exists no such test except running a sample in an engine. Mistakes in this area are costly (deliver the wrong fuel to an airport for example). A real world application for a nano-flow sensor.

To end here, I visited Park Scientific, manufacturer of Scanning Tunneling Microscopes (STMs) and had the experience of pushing individual atoms around with my fingertips (making contact with the surface and the STM, which then trasmitted signals to a haptic glove interface). After a few tries, the tip was no longer sensitive (too much stuff was sticking to it or had come off) and had to be replaced. This for me was evidence enough of the true challenges facing nanoscale manufacturing before it can ever be viable.

9:14) 06-FEB-2003 12:22 Jack Smith

Bruce Damer's comments are very insightful and worthy of further discussion by those who know more about the scientific state of development than I and indeed we should consider a scenario in which nanotech fails to fulfil its early promise (e.g. what balance of hype and real medical or product possibility?) What we are hearing from many sources is an imaginative range of (thought to be) eventually plausible applications, made one presumes under the assumption that the nanoscale forces, binders and molecular alignment determinants within material structures can be both manipulated more than at present and assembled into useful new devices.

I agree that there are too many unresolved issues at present to forecast either the time or shape of these prospective applications. The challenge we have set for our consultative group is to begin to imagine what kinds of Research would be useful or necessary to start doing soon to be capable of anticipating various developments IF they were to be imagined or treated as feasible or heading that way. So we are seeking contingent ideas of various types so that both boundaries of suggested as plausible pathways - from over hyped to under estimated could be considered by those who will be asked to draw research implications as we go forward with the foresight pilot approach.

9:15) 06-FEB-2003 12:32 Howard Rheingold

Don't forget the oft-quoted Paull Saffo quip: "Never mistake a clear view for a short distance."

9:16) 06-FEB-2003 15:15 Bruce Damer

Jack, I think therefore a good approach would be to start from existing observable fine scale nanoscale manufacturing process (biology) and extrapolate possibly valuable technological avenues from there. A great canonical example is the silkworm, which generates a strong, wonderfully propertied filament from a couple of feedstocks that react together in a chamber. Perhaps that is more on the micron scale but nano scale processes abound in living systems. Materials science I guess is more on the bulk scale of the nano equation. The STM or "place the atom one at a time" approach might be seen as a trivial case for now as useful structures are not being produced with regularity.

A whole series of research directions (your plausible pathways) could be derived from a bio-inspired starting point. What if we could reproduce the nanoscale crystal structure that tunnels photons in the green leaves of plants? Would that give us more efficient photovoltaics?

This may restrict the end products possible with nanoscale manipulation, but at least we are assured that we can attain working end products from the restricted subset.

I for one would love to be a part of any such brainstorming exercise.

9:17) 06-FEB-2003 15:27 Jim W. Lai

An example of bioreactors. Chinese scientists claim first stage success in implanting spider silk genes in silkworms. The report in passing of rabbit hair genes and cotton plants sounds bizarre, and IMO needs verification to be credible.

http://www.arachnophiliac.com/burrow/news/spider_silkworm.htm

9:18) 06-FEB-2003 15:43 Burl Grey

[Here](#) is something that sounds really dangerous to me: reminds me of Joy's "gray goo"!

"From time immemorial, every living thing has shared the same basic set of building blocks -- 20 amino acids from which all proteins are made. That is, until now: A group of scientists say they have, for the first time, created an organism that can produce a 21st amino acid and incorporate it into proteins completely on its own."

9:19) 06-FEB-2003 16:06 Jim W. Lai

There are actually several distinct genetic codes in nature, which appear to be variants around a loose theme. More complex systems could conceivably exploit this.

9:20) 06-FEB-2003 18:14 Nicholas Carroll

Veddy interest comments there, Bruce. (Haven't followed nanotech much myself, so all I hear is the upbeat side.)

9:21) 07-FEB-2003 20:30 Jack Smith

The NRC Canada has both mecho - nano inclined and bio -nano focused research groups who are being asked by us policy and strategy types within the organization to reach beyond their usual boundaries and consider each others perspectives and seek common ground - I have observed some of these discussions and I think that while they are indicative of mutual learning, the bio perspective is still quite limited in its horizons whereas the (mostly) materials folks are moving ahead within the current paradigm of ever stronger, lighter materials framed around current materials uses - so essentially we do not seem to be there yet in terms of being ready to imagine entirely novel configurations or applications of the nano capability. This suggests to me that the nano revolution we think may be accessible, may be further out then we think even given the previously mentioned speed-up aspects of technology acceleration.

Nrc Technology Foresight Workshop Item 9

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Nrc Technology Foresight Workshop Item 10

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)**10**[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

BioSystemics: Information and Cognitive Technology Observations

Item 10 04-FEB-2003 12:01 Moya K. Mason

These are the Information and Cognitive Technology Observations. Comments? Criticisms? What would you add?

The information and cognitive technology theme puts together two disciplines that are completely separated in the physical world, but are related in a conceptual world.

Information technology is a mature industry in some ways, yet continues to re-invent itself. Even in the simple world of mechanical calculation and sorting of cards, the potential for thinking machines, or "mechanical brains" was there. The IT topics included in this theme are broad and will likely change themselves over the next 10 years. They include items dealing with both hardware and software and point to what has been called "spiritual machines".

The second part of the Information and Cognitive Technology theme deals with the biological brain. Advances in imaging technology and improvements in sensors are creating the capability to discover what the brain does when it thinks. Not only are there medical and psychological possibilities in these technologies. There is also (although long-term) the possibility of reverse engineering some brain functions, thereby enabling the creation of hardware devices that perform some brain functions.

10:1) 04-FEB-2003 12:31 Jack Smith

That was - stretch our concepts - so a key objective of this Conference is to examine the imaginative possibilities that these two rather broad and even artificially labelled topics stimulate us to develop. The most intriguing area that we have not begun to explore in much depth is the premise that cognitive science developments could enable the brain and the computer to be quite readily linked in activity as well as in design - that we may be able to actually connect thinking patterns and neural design to processing of information needs that demand abilities that our normal consciousness rarely or almost never permits - a sort of update on what John Lilly once called the programming and meta programming of the human biocomputer. So if anyone has some ideas for how this domain might have evolved by 2020 please suggest possibilities.

10:2) 04-FEB-2003 12:42 Bob Watson

This pdf seems relevant: http://www.communitytechnology.org/nsf_ci_report/ExecSum.pdf

That's the Executive Summary of the final report of a **Blue Ribbon Panel on Cyberinfrastructure** (U.S. National Science Foundation).

It suggests to me that the "material world" and the "computing world" will be increasingly bound together, with real-time data available for myriad purposes. But I've got no idea who'll be reading the reports. ;-)

10:3) 04-FEB-2003 13:37 Howard Rheingold

I am slightly skeptical about this because of nothing more than a sense of hubris: Our knowledge of how to construct microelectronic components is vast, but our knowledge about how the nervous system actually operates is considerably less vast. It's easier to experiment with circuits than brains. I don't think it pays to assume too quickly that the state of knowledge about neural functions will advance as rapidly as knowledge of IT.

10:4) 04-FEB-2003 13:37 Burl Grey

I agree that strong skepticism is necessary because the rate and kinds of changes *without* cyborgs are already too fast and deep to understand, much less manage.

People like [Warwick](#) are certainly moving fast with his cyborgs.

And way back in 1996 Prof. Radermacher at the U of Ulm, proposed [this](#):

My emphasis.

" The paper proposes a four-level architecture for the cognitive apparatus of future autonomous systems, addresses the handling of nested time scales, tries a first step towards **a technical approximation of consciousness** as a linear abstract control channel within a massively parallel architecture..."

I believe we have to focus on deeper, more immediate and subtle ideas about the kinds of assumptions we share and how to engage each other without overload.

I quote a single idea from Lawrence Lessig's "The future of Ideas" page 5

"A time is marked not so much by ideas that are argued about as by ideas that are taken for granted."

10:5) 04-FEB-2003 15:11 Louis Atkinson

[This](#) interview of Ray Kurzweil by John Brockman on The Singularity touches on some aspects of this arena. The reference in the intro to "spiritual machines" had me dig it up.

One thing that I think may be one of Lessig's "*ideas that are taken for granted*" is Moore's Law as a sort of ceiling for the limitations of computing hardware. The linked interview changes the emphasis to it being a ceiling for the current paradigm of computing hardware. An example analogy being that the vacuum tube hardware paradigm also had a ceiling, which was superceded by the shift to transistors. The interview refers, as Burl's block-quote does, to a massively parallel (3d) architecture as a possible next step.

Here is the table from the BioSystemics report of potential transforms/paradigm shifts and their potential timelines.

Date	Technology
2007	Quantum computing
2010	Highest paid celebrity is synthetic
2010	Nano (chemical + direct) mood control
2011	Molecular computing
2012	Single chip real time translation
2013	Low-power PCs run for one year on batteries
2015	Biochips - 10 ¹² bits/cm ²
2015	Sensory chips - taste, smell, sound
2015	Photonics replaces electronics
2015	Ethical computer
2017	Tele-presence (primitive holodeck)
2020	Cyberspace covers 75% of populated world
2020	Functional mind-machine interface
2030	Robots mentally, physically superior to humans

Kurzweil has this to say about timescales and the speed of progress in what he calls the "law of accelerating returns":

But what's not fully understood is that the pace of change is itself accelerating, and the last 20 years are not a good guide to the next 20 years. We're doubling the paradigm shift rate, the rate of progress, every decade. So this will actually match the amount of progress we made in the whole 20th century, because we've been accelerating up to

this point. The 20th century was like 25 years of change at today's rate of change. In the next 25 years we'll make four times the progress you saw in the 20th century. And we'll make 20,000 years of progress in the 21st century, which is almost a thousand times more technical change than we saw in the 20th century.

or, as is said in the BioSystemics report "From the point of view of scientific experimentation, time will speed up."

Research of cyborg/AI might then be involved in an accelerating paradigm cycle of the feedback loop of reverse-engineering the brain to find algorithms for reverse-engineering the brain, with, perhaps, nanoscale (and smaller) tools to help refine those processes being refined.

10:6) 04-FEB-2003 15:14 Jim W. Lai

Cultural factors are not to be underestimated. They also bias our very cognitive models.

Individualism versus interdependency. Fundamental attribution error.

<http://www.azwestern.edu/psy/dgershaw/lo/PersonPerceptionEW.html>

This is a consequence of the dominance of analytical thinking in Western society, as opposed to dialectical thinking.

http://www.artsci.wustl.edu/~daweisko/ipcs/nytimes_culture_thought.html

10:7) 04-FEB-2003 15:40 Howard Rheingold

I resonate strongly with Kurzweil's insights about the increase in the rate of the pace of change, but I don't agree with him that we will understand the mind by deconstructing neurons. We already know that so much of human cognitive abilities are emergent (the result of the interaction of many biochemical/neural systems), embodied (the mind is not just in the brain -- there's an entire and extremely complex hormonal soup, streams of proprioceptions and perceptions from sense organs) and social (would we have intelligence without communication?) I am not implying that mind is immaterial -- just that it's not as simple as Kurzweil seems to think. It's like Freud's astonishing insights that much of human cognition is not conscious, wedded to the state-of-the-art 19th century model of the brain as a hydraulic system.

10:8) 04-FEB-2003 16:57 Louis Atkinson

I see your point, Howard.

Aside from understanding how the mind works, then, and if the research into how the parts of the brain operate with the aim of designing ever more powerful "Tools for Thought" continues, do you think that by 2020 we can expect some sort of breakthroughs towards sensory input and manipulative output integration between the mind and the world? Not thought i/o or cognition amplification, but merely the higher level interfaces to sense data and muscle control.

10:9) 04-FEB-2003 16:59 Howard Rheingold

The biggest payoff, of course -- and the place where human subjects are willing to experiment with radical modifications -- is spinal cord injury.

10:10) 04-FEB-2003 17:01 Jim W. Lai

Reinvigorating neural growth and plasticity could be part of a treatment to entirely reverse Alzheimers. Cases of severe degeneration might also be candidates for volunteers.

10:11) 04-FEB-2003 17:31 Nicholas Carroll

<slipping many, with a nod to Louis...>

From Jack's second post:

"... we have not begun to explore in much depth is the premise that cognitive science developments could enable the brain and the computer to be quite readily linked in activity as well as in design - that we may be able to actually connect thinking patterns and neural design to processing of information needs that demand abilities that our normal consciousness rarely or almost never permits.... So if anyone has some ideas for how this domain might have evolved by 2020 please suggest possibilities. "

With thanks to Howard for the overview of the brain's yet-unknown complexities: yes, and before hydraulics, people were imaging the body as a clock, a steam pump, or whatever the latest technology was (Jonathan Miller, "The Body In Question"). The analogies rarely endured long. Yet they had their uses. Thus I don't object to people playing with computer-brain analogies. Some are absurdly narrow; neurologists dismissed the analogy of brain as digital machine almost immediately.

Two analogies that still interest me are massive parallelism and quantum computing -- the first, because current neurology study indicates the brain does "run" parallel thought processes (albeit analog and chemical as well as digital), and the second, because of indications that under certain circumstances, the brain simply "goes directly to the answer", as is hypothesized for quantum computing.

[I am plodding towards answering Jack...]

My own disgust with the lack of integration between brain and computer flowered when I bought my first mouse. Within minutes I had removed my shoe and put the mouse on the floor where it belonged. The beast was crushed to death in a week, and I was one hand short of using a computer properly for years. A few years ago I acquired one of the original NLS/Augment "chording keysets" (essentially a one-hand keyboard), and with little surprise found that being able to use the mouse and keyboard simultaneously freed up substantial brainpower. That **was** Doug Engelbart's point, after all.

That transfer of some thinking from the cerebral cortex to the cerebellum raised questions, like how **much** thinking could be transferred? My suspicion is: a lot. The cerebellum may not have the sophistication of the frontal brain areas, but it certainly has horsepower.

[Plodding towards 2010...]

This impelled me to call Neil Scott at the Stanford Archimedes Project, and politely but relentlessly question him until he volunteered to give me a tour. I found a treasure trove of peripherals for controlling and interacting with computers, incorporating next-generation microchips, accelerometers, gyros, and cameras. Originally focused on devices for the disabled, their scope has expanded to integrating all manner of natural behaviors with machines. For lack of a better term, I call this "surface cyborgism." (Scott is not alone in this goal; I believe physicist Edward Teller's son is developing similar devices).

Some of the Archimedes work is fairly long-range, but I have no doubt that by 2010 they will have developed vast range of strap-ons for the human, and built-in sensors for the machines. I have equally little doubt that these devices will open up new and (hopefully) productive lines of communication between brain and machine. It could hardly be otherwise.

[Moving towards being proven utterly wrong by 2020...]

I think that as more channels of communication are added, humans and machines will start to "think together" to a degree unimagined today -- roughly the difference between a Neanderthal rhythmically thumping a log, and a modern symphony.

That's what interests me about the massive parallelism and quantum computing analogies. **Somewhere** in the mix, we are going to find areas where computers and human minds think in tandem -- perhaps to the extent that a user will be able to interrupt their dictation in mid-sentence, mutter "hmmmm", and have the computer speak up: "It might work. Want to try it?"

=====

Note: Ethically I find "surface cyborgism" much less threatening than hardwiring the human body. After all, when you are done with the machine, you can peel the accelerometers and MCUs and

modems off your fingertips or your nose or whatever, and head off to the kitchen to slice some onions for dinner, the same human you were when you arose in the morning.

Hardwiring, by contrast, has for years butted up against two assertions that continue to haunt me:

1. As Freud observed, "Anatomy is destiny." Change human anatomy via cyborgism, and the mind can hardly remain the same.
2. Karl Marx: "It is the fallacy of every age to believe it has defined the natural man."

Thankfully, previous generations were unable to do more than believe it. Actually being able to *do* it strikes me as building the "Six-Million Dollar Man"* and sending him into the labyrinth of the future without a ball of string. He might not find his way back to humanity.

* An American 1970s TV series about a cyborg man.

10:12) 05-FEB-2003 09:56 Jack Smith

One area that we have started to look at, following Marc Buchanan's very readable account of network systems - *Nexus -Small Worlds and the Groundbreaking Science of Networks* (Norton ISBN 0-393-04153-0) is how emergent systems may be changing our notions of how biosystemic linkages manage to develop, grow and propagate according to identifiable principles. Here is an excerpt from a paper recently drafted by Dr. Erik Lockeberg for the STFPP:

Networks in the context of scientific research can be classified as follows:

- Specific networks found in the objects of study, eg, food webs
- Abstract networks that are the objects of theoretical investigation
- Networks that form part of the scientific process, eg, networks of researchers, scientific papers, institutions

Some networks could fall into multiple categories, for example, various networks associated with the internet can be the object of study, as well as part of the scientific process.

There is a case for studying the networks that form part of the scientific process. The benefits would be:

- Enhanced collaboration between researchers from different organizations
- Effective publication and linking of findings
- Better communication between research, policy and implementation groups

For example, certain network structures may prove better than others at linking collaborating researchers and managers at different institutions, in which case, a conscious decision is taken to use these optimal structures when setting up new collaborations.

The opposite case could also be made, however, that a network structure is just one of many factors behind a successful endeavour, and it is just as effective to let the network structures evolve by themselves as a result of the researchers' desires to talk to each other, the managers' need to know what the researchers are doing, etc.

6. Discussion and Conclusion

The study of networks as described in this report forms a part of a much larger topic, the study of complex systems. Roughly speaking, a classification of complexity can be given as follows, for a whole consisting of a large number of interacting parts:

- Statistical regularity, but no structure. Example: An ideal gas consisting of atoms colliding according to Newton's laws of motion. Each atom interacts in a simple way with its immediate neighbours.
- Statistical regularity, with limited structure. Example: the "small world" network of human acquaintanceship. There is some structure because, in addition to the short-range interaction of two acquaintances, the long-range connectivity of the network is important.
- Simple patterns. Example: a salt crystal.
- Simple patterns with an element of randomness. Example: sand dunes.
- Complex patterns. Example: a fractal curve.
- Computational level of complexity. The term "computational" is chosen because the system is sufficiently complex to do arithmetic and logical manipulation. This may seem like a very high level of complexity, but in fact a rather simple-looking system can reach this level. Example: Conway's game of Life.

The progress of research can be analyzed as follows:

1. Simple relations between simple entities are found. The consequences of these relations are pursued. Examples: Euclidean geometry (relations between points, lines, lengths and angles). Chemistry (relations between atoms). Orbital mechanics (bodies moving freely under the influence of their mutual gravity).
2. Analyzing the details of interaction becomes too difficult when there are too many interacting entities. Instead ways are found to deal with the entities en masse. This is possible when there is perfect order (eg, a crystal), perfect disorder (eg, an ideal gas), or some cleanly separable mix of disorder superimposed on order.

... it is still possible to make good predictions using mathematics. But ...

3. Examples are found where some kinds of predictions are demonstrably impossible. Example: The three-body problem has no closed form solution. Example: The halting problem for Turing machines. There is no efficient general way to compute whether a Turing machine program will halt or run forever. The answer seems to be, run it and see.

Rather than giving up entirely ...

4. Methods are found to get useful results even for generally intractable problems using approximations and special cases. The intractability itself is analyzed to determine exactly what we can and cannot predict. Example: chaos theory.

This is the current state of affairs.

The hope for problem-solving is to decompose a system into components that can be understood separately, and combined in such a way as to elucidate the behaviour of the whole system. We now know that decomposition is not always as simple as looking at the parts of a system (the perfect crystal or ideal gas). The decomposition may determine that the system has features of:

- Parts interacting in a simple way (classic decomposition)
- Randomness (probability and statistics)
- Long-range connectedness (networks)
- Scale-free structure (the distinction between big and small disappears, fractals appear)
- Computation-level complexity (the level of biological life and computer programs)

Whether networks are an important enough principle to be identified at this level is debatable. We can say they are at least a candidate, which already makes them important enough.

To the extent that we have time and resources (limited) to explore the avenues of further development identified by Dr. Lockeberg, I think that emergent network principles and systems present one of the key integrative links within the biosystemic topic - they potentially bind both our human cognitive behaviours in groups and disease, food and ecological information flows in some manner we do not fully comprehend.

10:13) 05-FEB-2003 09:59 Raymond Bouchard

The computer-brain link is a very interesting area of speculation. I agree with previous commentators that we are not very advanced in our knowledge about how the brain works. That said, I don't expect that the first useful work in this area will come from trying to connect circuits to brain cells. It is much more likely that we will see success in forming 'connectors' that are able to repair breaks in the nerve channels in the spinal cord.

From there, my guess is that we will be able to 'reverse engineer' some of the autonomic functions (such as walking) that occur in the ganglions (ganglia?) that operate more or less independently of the brain. It will be a long time, perhaps never, before we understand the mechanics consciousness. But we will, I expect, be able in short order to be capable of relatively selective 'mood control'. This is already done primitively with drugs such as alcohol.

10:14) 05-FEB-2003 10:03 Bob Watson

Not only "we do not fully comprehend," but also **cannot** fully comprehend without imposing a system boundary. Such bounds are necessary for some types of study and analysis, but they're essentially artificial and chosen rather than "natural."

I think it important, in future public policy, to explain how such choices are made rather than leave the result as a "black box" from the POV of the public.

(slipped Raymond)

10:15) 05-FEB-2003 10:36 Jim W. Lai

Decomposition may get one further via massively parallel computing, but if higher order phenomena emerge, one may still have to rely on approximations, since such attributes may be the result of certain variables occupying strange attractors. One could argue that stable ecosystems comprise such quasistable states, which implies the modelling of collapse is not likely to tell us exactly what a new stable state will be (not without a fair amount of uncertainty, unless there are fairly large attractors that can be shifted to).

On another note, I recall Persinger and others were researching the neurochemical basis of religious experience. Going blue sky with that, perhaps in 15-20 years we may be able to induce numinous religious experiences on demand.

10:16) 05-FEB-2003 10:54 Howard Rheingold

I propose that humans are, by our nature (eyes, thumbs, frontal lobes), self-augmenting, and that walking upright, using language, inventing writing, alphabets, new forms of social organization, printing presses, levers, pulleys, steam engines, telephones, etc., we extend our nature into our environment (cognitive scientist Andy Clark calls it "scaffolding" for our nervous system). In other words, we're already post-human, from the point of view of past humans.

10:17) 05-FEB-2003 11:03 Bob Watson

Good point, Howard.

10:18) 05-FEB-2003 11:32 Raymond Bouchard

It does all come down to the nature of humanity, and from my reading of history, human nature has not changed much, even though the conditions, materials and tools may change some of our goals and the means we use to pursue them.

10:19) 05-FEB-2003 11:58 Howard Rheingold

Which means that an agreement on what human nature is essential to any evaluation of what we are becoming, and what we want to become, which brings us to one of the most divisive and long-standing disputes in human history: Are we basically good, and only require an environment that supports our goodness? Or are we basically sinful, and require restraints on our destructive impulses?

Another response to your statement, Raymond, is to respectfully question that received wisdom that human nature doesn't change. I think one needs to be quite specific. Yes, we have the same biological impulses. But do our social impulses and reactions remain invariant? For 100,000 years or more, we lived in small bands, hunting small game and gathering food, trusting only our blood relatives. At some point, organized bands of big game hunters extended that web of trust, just as the Shoshone do today, when their small family hunting units temporarily unite for the rabbit hunt that requires deploying huge nets, too large for a family unit. Have humans expanded our range of trust under certain circumstances, perhaps stimulated by the invention of new communication means and/or new social arrangements, through our history? Is "trust nobody who isn't a blood relative" a part of human nature that has changed? Have other parts changed? I think we have many old aphorisms and relatively little data in this regard.

10:20) 05-FEB-2003 16:37 Nicholas Carroll

"Are we basically good, and only require an environment that supports our goodness? Or are we basically sinful, and require restraints on our destructive impulses?"

There is a wild card that throws off efforts to develop scenarios based on either belief: psychopathy. Dr. Bob Hare of UBC believes that roughly 1 in 100 humans is a clinical psychopath, incapable of empathy or notions of right and wrong. That's a big enough group to destabilise most social models based on a theory of basic goodness.

Unfortunately, it's also a group big enough to create an exaggerated view of the average person's sinfulness -- with a commensurately exaggerated paranoia, that, particularly in the USA, expands the "prison-industrial complex", while overlooking the education and nurture of children. (Children, a.k.a. "future adults", who may turn out basically good, or not so good.)

10:21) 05-FEB-2003 17:32 Robert Crosby

"That's a big enough group to destabilise most social models"

And growing exponentially, as (1) population grows and (2) as technologies of mass destruction evolve, allowing fewer people to kill ever more.

Consider the difference between 10% of a population of 100 million armed with spears, vs 10% of a population of 6 billion armed with anything from suitcase nukes to box cutters and knowledge.

Are these some of the built-in systemic limits to growth?

10:22) 05-FEB-2003 17:52 John Verdon

I love Kurzweil and his description of accelerating change is dramatic food for thought and action. We are all immigrants for the past, and may experience the "trauma" of immigration every decade - future shock as a permanent cultural state.

This leads me to wonder about the state and direction of our educational system. In the 20th century it has functioned as a prime vehicle for enculturation. But in the world we are envisioning what will its role be? To provide knowledge content? I think not. But we will need stable and effective institutions for the socialization of our youth and the resocialization of ourselves. Access to technical knowledge will be simpler and simpler. My 12 year old has been to the library once to carry out a research assignment, and that was only because the teacher would not accept more than one internet reference.

What we will continue to have to teach is critical thinking, social skills such as consensus making, decisioning, collaboration, sharing, mediating, and transforming emotions (emotional intelligence/wisdom), how to make good decisions, the ethos of social systems. The need to begin the transformation of our educational systems grows exponentially with technological advance.

In many ways we are still at heart hunters and gatherers (when boiled down that's what shopping is). The mall is the modern agora. In our bones we know how to live completely public lives, anonymity is a very recent possibility and we may not be handling it very well. The technology we are envisaging is transforming the world literally into a village and we had better develop the social protocols, institutions, practices that will enable productive transparency. The speed of change and the ubiquity of access is forcing ever more rapid mechanisms of sensing, measuring and accountability. Our culturally rooted ethos of secrecy is not serving us the protection we need. David Brin "Transparent Society" makes a great case for choosing freedom as the fundamental base of our society, rather than privacy (as is commonly understood to be anonymity).

10:23) 05-FEB-2003 17:57 Jim W. Lai

Still the Western bias of individual determinism with regard to psychopathology. How much is neurologically induced versus socially triggered?

Education versus prisons is also another example of proactive versus reactive approaches. Reactive deals with symptoms. Proactive seeks to address causes.

10:24) 05-FEB-2003 18:09 Howard Rheingold

Here's the problem: public schooling as a political institution has diverged for cultural and political reasons from education, the cultural institution for training humans to cope with and contribute to civilization.

When my daughter was in middle school, search engines came along, and I had to sit down with her and explain that someone probably checked the facts in the books in her library, but SHE is responsible for evaluating the veracity and accuracy of what she finds on the Web. I typed in the word "Holocaust" and showed her sites that LOOK like historical scholarship, but are actually not. So I taught her to check multiple sources, to see what she could find out about the author, check the author's sources -- to think critically.

Try inducing a public school to teach critical thinking. First, in the USA it sounds like a communist plot. Second, few parents, even those who don't take that stance, don't want their kids questioning THEIR authority.

So school as a site of teaching critically important skills has a problem.

10:25) 05-FEB-2003 18:43 John Verdon

LOL, thinking critically in the education system - is it an oxymoron? I completely agree with your observation, and that's why it is such a challenge. The politics of search engines will only be out-controversied by the politics of recommendation engines. However, that is probably not much different than now, hopefully more transparent though.

How to we prepare children and society for a world where all knowledge (good and evil) is available? I think the debate is between protection (is it possible) versus inoculation (values, critical thinking, dialogue, etc).

Critical thinking is also resisted by ideological, religious, and other entrenched systems of authority. It seems that the purposeful transformation of our institutions must be adhoc, after the fact.

With convergence, what would be optimal electoral reform, educational reform, privacy definitions and regulation, intellectual property, taxation, the list goes on.

I spent some time working with emotionally disturbed youth, and then a year as a teacher's assistant in a normal class room. My conclusion, is that the ultimate therapy is education.

10:26) 05-FEB-2003 18:48 Nicholas Carroll

Yep to Howard. John, if you've only attended Canadian schools, it's hard to appreciate the politics of the American school system. It was essential driven by the lobbying of the post-Civil War robber barons, who were interested in compulsory education as a means of producing trained clerks at the taxpayer's expense. It had little to do with the "little school on the prairie." The schools continued to degrade in the 20th century with the impact of the "efficiency experts" such as the odious Frederick Taylor. (I suppose Canadian schools may have gotten a tinge of that; I wouldn't know, as I attended private schools during my years in Canada.)

In any case, I concur utterly with Howard on the difficulties of introducing critical thinking in American public schools. Coming here from British "public" schools, the difference was mindboggling. While I'm aware that British state schools can be tuned for nothing more than producing blue-collar labour, the public schools most certainly taught critical thinking -- and it wasn't the teacher who taught us to think critically, it was Jonathan Swift or Mark Twain. It was recognized that Swift was smarter than the teacher, and if we wanted to be as smart as Swift, we would have to damn well work at it.

As said, I've never attended public school in Canada. But if there is any of the British "public" school tradition, or the Scots tradition of education, then Canadians may have a better chance of introducing critical thinking than we do down here. Certainl your your level of literacy appears considerably higher. While literacy ain't critical thinking, at least it means some exposure to Swift and other great minds.

10:27) 05-FEB-2003 18:52 Howard Rheingold

Let kids play, give them tools, get out of the way. Don't mess up their natural desire to learn too badly. It's really simple. My mother was a teacher. It's the philosophy I used with my daughter and she turned out all right.

Substituting ideology for values, then convincing people through stories or fear that it really is value-related, is an old and bloody game.

10:28) 05-FEB-2003 20:12 Jim W. Lai

Canadians are introduced early to at least a hint of critical thinking, as I learned early on that sometimes American spin on history was different from how things actually (well, okay, bias there too perhaps) happened. I recall this as early as junior high.

10:29) 05-FEB-2003 21:10 Robert Crosby

"Let kids play, give them tools, get out of the way."

Sounds like an apt description of what ecological engineers do to "design" a wastewater treatment system -- as opposed to conventional sanitary engineering practice which is more like conventional educational system thinking. From my [website](#):

"The task of the ecological engineer is to understand the needs of the organisms, to create an environment which serves those needs, to seed it with selected organisms, and then let nature do the rest. When properly done, natural processes co-evolve a diverse, robust, self-sustaining system without requiring further human intervention."

10:30) 06-FEB-2003 01:29 John Verdon

I would have to agree with the above comments concerning the introduction of critical thinking in any formal educational system. As I understand the industrial education system, it has more to do with baby sitting and producing workers indoctrinated to protestant work ethic schedules and obedience within the system. I believe children have a "natural" drive to learn else we would never learn to walk and talk.

But my point is that however, difficult it is to transform the education system it must be done. And that the main point of its transformation is not knowledge content, but the socialization it delivers (which must include the capacity for critical thought in the emerging democratic potential of convergent tech). That socialization has to focus on social and emotional tools for colaboration, participation, mass-decision/governance processes that convergence will enable.

In South Korea, online games are national pastimes. Whole hordes of youth align in cyberspace to carry out e-military tactics and strategies involved with games ranging from the more individualistic American games such as Warcraft, to more Asian approaches where each person control one avatar (soldier) that must synchronize with hundreds of other within a traditional military mass warfare maneuver. These games presage the decisioning process of more important governance systems.

If our economy continues to innovate at accelerating rates, then disruptive technologies become a routine social restructuring and the challenge in that type of world is the sustainment of trust and social cohesion. For that we need some serious attention to how we socialize and re-socialize ourselves and continually recreate our social insitutions.

10:31) 06-FEB-2003 02:58 Bruce Damer

Going back to some of the original questions about cognitive science and its confluence with computing (or technology in general), one thing to consider is that heavy daily use of computing environments may have profound effects on cognitive development. Some evidence of this is presented below:

We here at Digital Space do a number of projects with NASA to model (in 3D virtual worlds with avatars and bots) life aboard conceptual Mars habitats and the real International Space Station). One of the persistent problems people always encounter in these environments is constant cognitive overload. Astronauts are bombarded with message traffic (com calls, emails, sensor alarms, readouts, to-do lists, and requests of colleagues on board) and get mentally tired. When an astronaut is working outside the station, they often get mentally exhausted before they are physically exhausted. In some sense, these astronauts are "canaries in the mine" for the rest of us. As our home offices and PDAs become more wired, more deluged with signals, we will all become astronauts in time.

The new emerging medium of multi-user virtual worlds (some shown at <http://www.digitalspace.com>) is pushing this envelope even further. People in these environments truly lead "second lives" with a full complement of social interactions and objects in 3D space (which they strongly identify with as if those objects were in the "real world" around them). It could be argued that they (almost always younger than us here) are pushing the envelope in cognitive capacity (and being diagnosed with ADD in their local school for it?).

So where is this all leading? Pioneering acupuncture practitioner and author Mark Seem tells me that his practice in New York is now seeing a great increase in patients complaining of symptoms he is calling "adrenal syndrome". He has traced this back to people sitting in front of screens engaging in rapid eye movement (thus stimulating a flight or fight adrenal response.. ie: being "wired") while their bodies stay put. Inevitable crashes of energy level in the day are supplemented with caffeine and eventually these patients become fairly dys-functional in the world. Indeed they need acupuncture to "reboot" the nervous system.

I feel this kind of thing happening to me, do you? This goes way beyond simple concepts of "email addiction". People forget to blink, they forget to breath. If in early childhood computer/messaging/wireless device use is added on top of the already profound cognitive shaping effects of flash-action television, we may indeed be creating a whole new generation of citizens whose cognitive processes are very different from what we now take as the norm (critical thinking possible anywhere in there folks?).

These concepts are not new but I thought this would interest this forum. A full discussion of this has been going on for a year or so over in the Brainstorms "Interrupt Culture" conference under Culture if you are interested. That group is planning a book (of 3 page chapters necessarily) and a conference at some point.

10:32) 06-FEB-2003 02:58 Bruce Damer

With reference to the “Reverend Ray Kurzweil” as he was referred to at the recent PopTech conference, I concur with Jaron Lanier.. as a species we are really not very good at technology and we are especially poor in software. We build and rebuild the same systems over and over and with each generation often develop more problems than we solve. The software business is mired in a quality crisis and an exponential increase in complexity as APIs (Application Programming Interfaces) bloat code beyond all reasonableness for little gain in value. Here at our farm in northern California I have a museum packed with vintage computers (mostly working, see <http://www.digibarn.com>) and I can tell you without a doubt that our 22 year old Xerox Star workstation, which does 80% of what my Windows machine does today with a more consistent interface, is proof positive of the falsehood of perceived progress in software.

Therefore, as much of our hopes for the future pivot on the belief that “software will make it all so easy” I think it is clear that dreamers like Ray are standing on a foundation of sand (quicksand even). We will no more have a singularity by 2025 or 2225 than we will be able to keep primates from wanting to beat the stuffing out of their fellow primates. If we can simply survive the coming Century, with all of today’s very scary negative trends (paranoia, demonizing of groups or nations, reduction of free speech and the public commons, collapse of the corporate/equity system, co-opting of governments by special interests, ticking fiscal time bombs, and a tearing of the planetary ecofabric) then I think we will be truly fortunate. I feel strongly that the time for idle dreaming about technology for its own sake must end, it is a waste of precious critical thinking! We must put good minds onto the big problems. If we end up in 20 years in a global guerilla war cum 11th Cenutry crusades between the world’s faiths and the rich and poor, then all our gadgets will either be smashed in the conflict or tools of the conflict and we will truly enter a new Dark Age.

10:33) 06-FEB-2003 11:34 Jim W. Lai

I'll interject with regard to mass gaming in South Korea. I believe there is a cultural factor in play. Some cultures may be predisposed to individual action, while others (communal cultures) may favor mass action. Synchronization appears more difficult for North Americans.

Any comments about BPSS and ebXML (and similar efforts) as a sign of future declarative programming for business processes?

10:34) 06-FEB-2003 12:41 Jack Smith

The discussion of cognitive overload and it being out of sync with the physical realities of our human form - raises the dual prospects of when and how we could use avatars as intermediaries for our work or other functions and what form of physical enhancements through implants, cyborg elements and wearables could help or alternatively accelerate this situation - indeed maybe we are already seeing the digital divide and its real cleavage - not one of access, knowledge or capability as most of us have imagined but that of a significant difference in neural pattern and intensity and nervous system tolerance for the flow and pressure patterns of multitasking, network structured resolving and electronic stimuli being processed by different kinds of neuron-mental architectures than we thought.

10:35) 06-FEB-2003 14:39 Burl Grey

I associate myself with many here who question the immutability of 'human nature', whatever that can mean.

If we are talking *only* of basic metabolic and structural features of brains like prefrontal dominance over other brain structures, then OK.¹

If, however, we are talking meaningfulness and feelings [what it means to be human] then I believe we are up against deeper problems²

"For example, work from my laboratory has shown that emotion is integral to the processes of reasoning and decision making, for worse and for better.

This goes to the *heart* of human meaning and values.

At a still deeper level I claim Georg Simmel's [observation](#) in 1900 My emphasis:

*"**Money** in the modern world is more than a standard of value and a means of exchange. Over and above its economic functions, it **symbolizes and embodies the modern spirit of rationality, of calculability, of impersonality.**"*

is possibly **the** intractable 'systemic' problem today because our very imbeddedness in a possibly catastrophic version of Chardin's 'Noosphere' is overwhelming and controlling for individual minds with [this](#) freedom to invent reality.

The human mind thus cut lose from the natural world of incomprehensibly subtle and probably unknowable planetary ecologies may very well succumb to Bill Joy's 'gray goo' and as Bruce says in 10:32 we enter a new Dark Age.

The extreme asymmetry now increasingly enabled as Robert Crosby mentions in 10:21 are likely *"...built-in systemic limits..."*

We all know deeply, that it is easier to disrupt than design and build.

An interesting related idea is [here](#).

"Charismatic leaders and media personalities can be destabilizing influences on social groups, according to various "small-world network" models."

I think the ideas called 'scientism' as described in John Dupre's "Human Nature and the Limits of Science 2001 Oxford" must be factored in any serious study of human meaning.

From the introduction page 18

"...distinctively human capacities derive from the social context in which human individuals are embedded..."

To present the full flavor of all this seems especially difficult in a forum like this.

[1] Deacon's Symbolic Species page 254+

[2] Damasio's The feeling of What Happens page 41 [anyone who knows nothing of this area is 'out of the loop']

10:36) 06-FEB-2003 14:56 Burl Grey

I forgot to appreciate "library" Bob's several mentions of "who" is reading what and why. For me that goes to the questions raised in "LINKED" about nodes in networks like my link above on Demagogues.

10:37) 06-FEB-2003 15:04 Bob Watson

(Most kind of you, Burl.)

10:38) 06-FEB-2003 17:43 Nicholas Carroll

Going back to cognitive overload: yes, *I* certainly feel it. I fight back by not having a TV, by printing out hard copy and going to a quiet room to read. Still not enough. Wish I had 4 hours a day for swimming, and I wonder if that would be enough.

William Calvin, a neurobiologist at U. of Washington

(<http://faculty.washington.edu/wcalvin/index.html>) would almost certainly aver that this cognitive overload will alter the human mind over time -- but I don't know what kind of timeframes he would suggest, nor what specific outcomes. (Meanwhile, it's going to be pretty hard on the "canaries in the mine.")

10:39) 06-FEB-2003 18:10 Jim W. Lai

Perhaps ADD and depression in the West are such caranies? It takes effort to keep up with the bandwidth requirements.

Ironically, I've opted to disuse my television set partly because I found its method of presenting information to be too slow for my needs. Inflexible tempo perhaps is the common issue.

Nrc Technology Foresight Workshop Item 10

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)**[10](#)**[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Nrc Technology Foresight Workshop Item 11

[Home](#)Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)**11**[12](#)[13](#)[14](#)[15](#)[16](#)

BioSystemics: Systemic Technologies Observations

 Item 11 04-FEB-2003 12:03 Moya K. Mason

These are the Systemic Technologies Observations. Comments? Criticisms? What would you add?

The Systemics theme addresses the integration of theories, mostly through the use of models and simulations. It is expected that data and basic observations about material at the nanoscale can be modeled to predict the properties to the material once it is aggregated at a larger scale. For example, the astronomical observations of Kepler and others were put together to form a theory of the law of gravity by Newton (and others).

The development of Systemics technologies could easily move forward with the development of the bio-nano-info/cogno sub-themes. Moreover, its development should be vigorously encouraged, for two reasons. The first is that Systemics technologies would greatly enable the investigation of holistic solutions to a broad range of problems. The second is that the radical and revolutionary bio-nano-info/cogno technologies could easily create new problems themselves. Systemics would enable us to anticipate these a bit better.

It is possible that all kinds of behaviors could be modeled.

- Extensions of epidemiology to include a much broader range of environmental variables
- Models of plants or cells to predict their reaction to a broad range of stimulations
- Predictive models of the impacts of genetic modifications
- Network models that could simulate the flow of traffic and information in the presence of multiple, independent, software agents.
- Predictive models for social behavior, including such things as ethics as independent variables.

 11:1) 04-FEB-2003 15:25 Geoffrey Gurd

The determinants of health, which epidemiologists are and will be busy tracking, will no doubt multiply as we both sub-divide them and discover new causal connections.

Likewise, although considerably more difficult, will be the enumeration of the factors influencing social behaviour. These in turn will be used to develop modelling programs for predictive purposes (or fun - think of the Sims program).

Predicting and managing organizational change could be improved through the holy grail of modelling human behaviour.

11:2) 05-FEB-2003 10:11 Raymond Bouchard

I would say model social behaviour. Whenever I get down to Queen St W in Toronto I have a difficult time understanding why anyone would dress in black leather (in the summer), be covered in tattoos and have dozens of piercings. From my cultural perspective that seems self-destructive. However if I see a group of three or more such citizens all of a sudden it becomes somewhat understandable. The emergent group activity is somehow more predictable than the sum of the individual activity.

11:3) 06-FEB-2003 10:44 Norm Willis

I think that the modelling should not be based on predicting behaviour of people or populations but rather on identifying where problem areas could arise and hence serve as a method of focusing attention in advance of a crisis or negative reaction to technological change.

Nrc Technology Foresight Workshop Item 11

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)**11**[12](#)[13](#)[14](#)[15](#)[16](#)

Nrc Technology Foresight Workshop Item 12

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)**12**[13](#)[14](#)[15](#)[16](#)

Convergence, Socio-Economic Impacts and Policy Implications

Item 12 04-FEB-2003 12:10 Moya K. Mason

Business, academic, and government leaders in the US have undertaken a major study of converging technologies. Their report, *Converging Technologies for Human Performance* (National Science Foundation, June 2002) calls for a tripling of the research budget to prepare the U.S. for the profound socio-economic impacts of this transformational technology. One contributor highlighted the following powerful characteristics that would have major policy implications:

How do you view the following list? Are the points realistic? Please comment, discuss, and add to the list.

1. Costs will crash due to many new efficiencies.
2. Systems will become much more customer-centered and personalized
3. The world will be 24-7, always on.
4. There will be a high value placed on convenience.
5. It is convergence of technology that will drive the low costs, expanded capabilities and convenience.
6. Process will be expert-system empowered.
7. The middleman will be gone.
8. Changes can come from anywhere.
9. Resources will shift from opportunity to opportunity.
10. The rapid introduction on new, better, less expensive products will lead to continual obsolescence and replacement.
11. The focus will be on success.
12. Venture capitalists will focus on opportunities. (The government will focus on problems).
13. Real breakthroughs will create new products and expectations.
14. Speed will matter. New things will need to be done quickly.
15. Opportunity will start small but dream big.
16. The first big profit opportunity will be business-to-business.
17. Applying quality and lean thinking will result in big savings.
18. Partnering will be essential.

12:1) 04-FEB-2003 12:28 Howard Rheingold

Convergent technologies often lead to unexpected -- and not always beneficial -- emergent effects.

Venture capitalists? They often respond to herd instincts. Right now, they are laying low.

Applying quality? Would that it could happen so easily. The gross productivity of every organization in the world could jump measurably tomorrow if everyone who sent email spent three seconds composing an appropriate subject line. This is not a joke. Doug Engelbart, way back at the beginning of the PC and Network revolutions, noted that he was aiming for a system that combined humans, methodology, language, training, and artifacts. Huge progress in artifacts. Zero progress in training. How many emails did YOU get today with no subject line? Or "about your email" as the subject line? Or was cced to way too many people? Or which exposed a hundred email addresses on the "to" line, leading to a cascade of bewildered, then angry responses?

12:2) 04-FEB-2003 12:47 Bob Watson

There also needs to be some definition, IMO, to the idea of "opportunity." Venture capitalists are in the game to make money rather more than they are to "do good." Government generally fixes the resulting problems (or bails them out in US experience!) but it would be good (in some sense) if policy helped steer VCs in useful directions.

12:3) 04-FEB-2003 12:49 Drew Fullerton

Reference 12:1, first sentence. Any ideas on how to ascertain what is converging? when it might occur? and potential ramifications?

12:4) 04-FEB-2003 15:38 Geoffrey Gurd

How one reacts to many of these ideas starts with one's perspective of human nature (good, bad, still not sure...). For example, 1. costs will crash due to many new efficiencies, but this wont be passed on to the consumer because the profit motive is just too darn strong. A small example, your Tommy Hilfiger shirt is made in asia and still costs a bundle.

8. Changes can come from anywhere. This assumes less about human nature and more about the nature of change itself. The assumption is that endless empowerment occurs which leads to some change, when change is more often driven by specific people with specific interests. There are also buried assumptions here about the presumed power of the individual to make things happen, and consequently a glossing over of structural factors.

12:5) 04-FEB-2003 15:49 Jim W. Lai

Active watch of research developments would identify technologies on the near horizon. Monitoring advances in engineering processes would identify candidate technologies near to mass commercialization. An application watch group and think tank, perhaps as part of a convergence research center could react. While this is admittedly optimized towards the near-term, similar approaches could reduce the cycle time from development to policy. Convergence research centers in partnership with business could also accelerate cycle times from development to cost-effective application. Manipulation and/or moderation of the structural factors.

12:6) 04-FEB-2003 17:17 William Pugsley

Referring to Moya's list, many of the symptoms cited are the result of horizontal and extremely quick (little time for reflection or digestion) communication of ideas, policy and plans that previously were (and still are in parts of government it seems) top-down - especially in well connected societies such as in Canada, USA and Scandinavia - and even in Iraq where it is said that orders were sent to field commanders by internet because the country's communication infrastructure had been bombed/destroyed.

One result- as it comes to this topic is that there are policy implications in many more things because of the greater flow and exchange of needs and information - one recalls the fictional flurry around cold fusion several years ago that had impact on the direction of S&T even if for only a short time. (one might also enter the panic over mad cow in the UK as an example of over reaction in a policy sense to a seemingly scientific issue).

What this implies IMO is a rise in importance and significance of the communication expert ("Spin master") and the need for policy developers (and makers) to be increasingly sceptical about "new" or future science - including what we're talking about here <grin> - and to develop equally quick and efficient ways to verify what is being proposed.

Bill

12:7) 04-FEB-2003 17:25 Bob Watson

Good point, Bill. But how does one get an "expert on call" when needed?

One could have a pool of folks in a Caucus-like environment checking in on a daily basis to see if they've anything to contribute.

12:8) 04-FEB-2003 17:45 Jim W. Lai

A Total Technological Awareness agency, a nonpartisan think tank, or equivalent body of assembled volunteers dedicated to monitoring trends? A stable of experts capable of analysis (and Delphi method critique?) in order to filter out spin-induced chaff and hash out quick scenarios?

12:9) 04-FEB-2003 17:48 Bob Watson

Should be a blog devoted to the thought in that last sentence, IMO.

12:10) 04-FEB-2003 21:47 Nicholas Carroll

For "spin-induced chaff" it's hard to beat this one:

"11.The focus will be on success."

In business? I once told an older business veteran, "If I ever write a book about business, it will be titled 'When Business Meets Emotion, Business LOSES'" He replied, "Every time."

12:11) 04-FEB-2003 21:51 Howard Rheingold

The US Congress Office of Technology Assessment did a pretty good job of being a "Total Technological Awareness agency, a nonpartisan think tank, or equivalent body of assembled volunteers dedicated to monitoring trends" before their budget was zeroed by the Gingrich Congress.

12:12) 04-FEB-2003 22:00 Nicholas Carroll

<drifting>

I had friends at CTO; they were a pretty sensible lot. Odd coincidence that the most credible economic figures come out of the Congressional Budget Office (or at least did when Alice Rivlin was running it).

12:13) 05-FEB-2003 01:24 Nicholas Carroll

After reviewing the NSF list at length, I must conclude that the War On Drugs has failed, and there is some rather potent ganja making the rounds in Washington.

1.Costs will crash due to many new efficiencies.

In some areas, yes. And in some areas, revenues will plummet due to false efficiencies.

2.Systems will become much more customer-centered and personalized

The contrary has been occurring so far.

3.The world will be 24-7, always on.

An interesting prospect, that -- convincing the French and Italians not to take August off. Certainly Madrid has suffered a bit of stress over that social model.

4.There will be a high value placed on convenience.

Yes. "Over-convenience", even. Part of the success of FedEx was that it made people feel important.

5.It is convergence of technology that will drive the low costs, expanded capabilities and convenience.

Nice sound bite.

6.Process will be expert-system empowered.

One hopes with smarter experts than at present.

7.The middleman will be gone.

Poppycock. Traditional supply chains for hard goods are indeed shortening. Yet at the same time there has been a rise in what one might call "expeditors" -- companies that can make the connections (and sometimes translation or cultural smoothing) between distant suppliers and customers. This does not entail giant warehouses, and will probably not be the same dollar revenue, but expeditors will be around, and their profit margins may be higher, even if the volume is less.

As to traditional middlemen, it depends on industry. Food, for example, requires high sanitation, moderate security, and continual refrigeration. A direct supplier-to-restaurant chain would drive both farmer and restaurateur into bankruptcy.

8.Changes can come from anywhere.

The French said it more tersely, but I still like Dwight Eisenhower's version: "Things are now more the way they used to be than they ever were before."

9.Resources will shift from opportunity to opportunity.

True, though not necessarily desirable. In the U.S., "human resources" turn on a dime. Employers fire people without notice, and employees in response have learned to quit without notice. "Customer loyalty", which was never reliable anyway, has plummeted. In business "dual-sourcing" as a means of self-defence has mutated to "apparent-ROI-plus-sex-appeal" sourcing.

10.The rapid introduction on new, better, less expensive products will lead to continual obsolescence and replacement.

Yes and no. Why are Toyotas still popular? Because they rarely require replacement. Why do I toss my old computer in the rubbish? Because it's not worth upgrading. This is along the lines of a John Naisbitt "high tech, high touch" contrast. Some products retain their value for decades, others for

only years.

12.Venture capitalists will focus on opportunities. (The government will focus on problems).

And both will succeed in creating problems.

13.Real breakthroughs will create new products and expectations.

Dwight Eisenhower again.

14.Speed will matter. New things will need to be done quickly.

In this brave new 24/7 world, I have not seen any change in human sloth. The chief difference seems to be that many things *can* be done more quickly -- and on the occasions when energy prevails over sloth, usually more poorly. Hence the slow-moving bricks-and-mortar merchants are inheriting ecommerce.

15.Opportunity will start small but dream big.

I believe Titus Livius noted that.

16.The first big profit opportunity will be business-to-business.

That should have been past tense; Cisco was moving billions in merchandise off their web site years ago. Not that they had much choice. Their highly sophisticated tech customers were asking, "Why do I have to yak with your salespeople? I just want to punch in my order!"

17.Applying quality and lean thinking will result in big savings.

Quality sells to a particular mindset -- and probably not to a prevailing mindset in America, where the phrase "good value" is unknown. "Lean thinking" has no meaning that I can discern.

18.Partnering will be essential.

Partnering has always been essential to those who "work the corners." Businesses that work the centre tend to find that partners slow them down, waste their time, and cut their margins.

12:14) 05-FEB-2003 06:21 David Brake

I am stunned at the apparent technological determinism and business/profit focus of that report... Technology may have tendencies but they are always filtered through social and governmental frameworks. As Nicholas says - try telling the French and Italians that they have to be 24/7 now...

By the way a quick google reveals the report is at <http://www.wtec.org/ConvergingTechnologies/> (it's a 7.3Mb file)

I agree that the middleman may disappear in some places but new middlemen are likely to emerge in others.

12:15) 05-FEB-2003 08:22 William Coderre

I keep waiting for the next generation of PCs which use their excess capacity to make the user feel smart rather than stupid. It seems to me the PC world is still the playground of the ultra-techno-literate who design the things to show off before one another. When we get easy access (voice probably), really user-friendly avatars and anticipatory services, there will be an amplification of human brainpower that is unprecedented.

Couple this with the increasing numbers of former wage-slaves with several decades of good mental time before them and we have another revolution. Time was if a man survived his working years he became wise. We are soon coming to an era where the wise can almost number the workers. If this situation does not degenerate to the level of passive TV watching and irreality-survivor Thrill-a-minute, we could enjoy a renaissance of mankind free to express and exchange thoughts all assisted by AI (Augmented Intelligence) systems. With such potential, many of Tad Homer-Dixon's Ingenuity Gaps could be closed.

12:16) 05-FEB-2003 10:37 Raymond Bouchard

I don't think that David should be "stunned at the apparent technological determinism and business/profit focus" of the NBIC focus. It happens all the time. Hustling new products and services is after all what drives what we variously call progress, economic growth, evolution, etc. Of course it is not really progress, but time and again we see that a 'right' or 'sensible' solution does not happen. Many posts in this discussion have pointed out the folly of business/technical processes. Why do people in cities drive large vehicles - trucks in fact?

One of the reasons that we focussed on technology in this study (apart from the fact that it was the NRC behind it) is that technology is one of the most deterministic forces around and that (I'm going out on a limb here) it may be the only one over which there is anything resembling management control.

12:17) 05-FEB-2003 10:49 Jim W. Lai

Middlemen may still emerge in markets where there is risk that can't be absorbed easily by the parties at the ends of each transaction. Market makers for organization. Insurance and banks. (E.g. repackaging of mortgage debt into mortgage funds one can invest in. Although the report focused on profit, it's not overly concerned with financial risk mitigation.

Some middlemen (e.g. RIAA) are fighting to entrench their existence via political justification rather than via technological dominance. For them, the empowered PC is a potential threat to their control over relevant dependency webs (and gateways or tollbooths). Government may play a role in keeping innovation from being strangled in the crib.

Speed matters at a strategic level. Boyd's OODA loop. Those who adapt fastest survive. Earlier exploitation of market disequilibria leads to greater profits. However, there's a social side to this as well: the faster a society adopts new technologies, the earlier they can find new uses for it. Witness the cellphone, webcam, online journalling, and instant messaging world of today's teenagers. The gap is a lot bigger than merely being unable to set the clock on one's VCR.

There's another policy consequence of the adaptation cycle (or the cybernetic feedback loop). Even if the USA is faster at the R&D mechanics of bringing research to the fore, Canadian society could still get inside their loop if there's an aggregate adaptation to technology that is faster than the USA. Deeper familiarity and integration may spur more radical revolutions from a combination of technologies. (Am I repeating myself yet?)

12:18) 05-FEB-2003 11:00 Bob Watson

Not yet, but I'm waiting. ;-)

I also think it important to consider that technology isn't just one thing. One may not believe in Kurzweil's projections as to the speed of future technology change, but I think one can agree that change is accelerating and has yet to reach a plateau. With greater change comes greater potential diversity, I think.

That said, the **chosen, optimal** tech of Canada may not be the same as the tech of the USA or elsewhere (except as the professionalization of technological education ignores borders and as technology is reflected in market choices). More choices may mean greater differences.

12:19) 05-FEB-2003 11:18 Jim W. Lai

Sometimes being first out of the gate isn't necessarily an advantage. It presents a fixed target for competitors to exceed. The international competition between HDTV standards is illustrative of such.

Let's get deeper here. Canada will have different underlying cost-efficiencies than the USA. Thus, deployment of technology will reflect such differences.

If change progresses faster than society can absorb it, perhaps we will have to cherry-pick technologies we see as being more useful. Again, something think tanks and convergence centers (application tanks?) could target.

12:20) 05-FEB-2003 11:31 Bob Watson

And yet -- international markets and international companies may undercut or minimize potential differences.

Consider: will Canadian hydropower or methane hydrate resources be developed as "Canadian" interests or for the money to be generated by international sales?

12:21) 05-FEB-2003 11:35 Jim W. Lai

Both. You're talking about a country that has previously been criticized by some as "hewers of wood and drawers of water". Resource export is ingrained into Canada as a means of making money.

12:22) 05-FEB-2003 11:39 Bob Watson

Heh. So does the USA (agricultural exports) -- but it tends to forget about it.

But the thing is -- there's an ongoing review that will have to be made (in some sense) outside a NAFTA midset if a "Canadian" tech (in terms of resource development) is to be developed and deployed.

12:23) 05-FEB-2003 11:46 Adam L. Gruen

It's the old engineering joke: "with enough time and enough money, you can do anything." A joke, of course, because what that describes is a stool that rests on four infinite-length legs: schedule, budget, capability, and risk.

Every technology development program has limits. The question is: how much money (alt:resources) is Canada willing to devote to tech development, over what timeframe, to achieve what objectives? And how much is it willing to gamble?

If you want a safe bet, quickly, with limited resources, then that steers you towards certain technologies, obviously, and away from others.

12:24) 05-FEB-2003 13:00 Louis Atkinson

For a Socio-Economic impact upon individual citizens, flexible income models as different job domains become obsolete might somehow need to be addressed. As with the Ned Ludd types, many people like to know that they will be able to feed their families. Even if they have the knowledge that new opportunities are available, some of the utopian "imagine if..." marketing probably scares off many people more than excites them.

12:25) 05-FEB-2003 15:00 David Harries

"Socio-Economic Impacts and Policy Implications" in most states (I assume states will be around for a while yet) are the game-balls of military-civilian relations=governance.

- Every person in uniform is a member of society, has family of civil society, and engages in socio-economic circumstances

- The end of the Cold War provoked or was followed by actions and reactions that massively complicated military affairs.

- the "technology imperative" always complicates military life, but particularly in multilateral/coalition-of-the-willing settings.

- "9/11" lifted the complexity of military affairs and their control and governance by another order of magnitude

- Soon? there may be more "private" security and military "soldiers" than state-owned ones.

- Many militaries' biggest battles now are within; to transform or not to transform, how and when, and what to do with "legacy" stuff???

- If even a minority of the items on the list that begins this chat space come to pass, military organizations, planning, procurement, life cycle management, etc will have to change....

All to say that, selon moi, thinking about C, S-EI and PI apart from or separate to "security" (of whatever field or function) may be very, very unrealistic.

12:26) 05-FEB-2003 18:15 John Verdon

The socio-economic impact of convergence tech? I think about policy implications. What is the equivalent of cyber-utilities (as in water, electricity, phone). In the polyvocalic world the role of government may be to nurture, support, fund various open-source platforms - level playing grounds for both business and citizen. Some new institutions of regulation and some new public utilities are vital. New measures of GDP, productivity are equally vital as is the resolution of concepts of intellectual property. Big Music has become a barrier to [music-related] innovation and the sustainment of broad-based creative talent. To sustain knowledge generation and flow will require not only intellectual property policy, but the technology to identify, track and credit intellectual and intangible contributions to the e-economy.

Convergence invites the sharing of bits (from Napster to Kaza) and to sustain a taxable social economy we need to get a better hold of intellectual capital. There is a whole domain of social policy infrastructure that is missing. Proprietary vs open-source, big brother vs transparent society, freedom and security, are some of the polarities that are unresolved and more - not being taken to the public fora for prolonged and complete debate.

Along with the above is the organizational forms, structures and cultures that can optimize the usefulness of convergence, while managing their destructive potentials.

12:27) 05-FEB-2003 18:20 Howard Rheingold

Professor Yochai Benkler claims that the peer-to-peer organization and production methods exemplified by open source software projects ("commons-based peer production) constitute a new form of organization that can take its place with firms and markets:

http://www.wikipedia.org/wiki/Coase's_Penguin

12:28) 05-FEB-2003 18:45 John Verdon

Howard, thank you very much, that is a great reference. There is so much to know!!!

12:29) 05-FEB-2003 18:58 Howard Rheingold

John, I was reaching for a good resource to explain Coase's Penguin, the Wikipedia entry was so lucid, succinct, and rigorous, that I looked at the home page:

http://www.wikipedia.org/wiki/Main_Page

An open-source, totally voluntary, knowledge community swarming on a project of literally encyclopedic dimensions. Something is going on here. How does it work? How are people motivated to contribute, how is quality controlled, disagreements adjudicated? How do the editors edit each other.

Something worth studying there. And I happened upon it in pursuit of this conversation.

Here's a convergence that includes computer-mediated interaction, the combination of recommendation and search engine in Google, the everybody-can-edit medium of Wiki, all riding on Internet architecture, which results in a novel solution to the collective action dilemma ("it would be nice if people would voluntarily create a free, accurate encyclopedia...but why should they?") and the creation of a useful and self-expanding public good. The convergence is between not only technologies but forms of social organization.

12:30) 05-FEB-2003 20:18 Jim W. Lai

The Canadian recording industry's tariffs on recording media and slovenliness with regard to payouts for artists is not an encouraging situation. They want to jack up the fees significantly. At the proposed rates, the majority of the cost of a bulk CD-R would be the fee.

<http://www.wired.com/news/digiwood/0,1412,57114,00.html>

Will they want to tax broadband and computer hard drives next, because of P2P filesharing, if we extend the copying tariff rationale?

12:31) 06-FEB-2003 01:35 John Verdon

Howard, thanks again, I've not had the time to do more than a superficial scan of the site, but yes. This is sort of synchronicous. It promises insight to some questions that have pre-occupied lately. Working for the Military as an HR "futurist" has forced me to think of the profound effect that convergence tech has for traditional "chains-of-command" approaches to social structure.

12:32) 06-FEB-2003 18:06 Nicholas Carroll

Chain-of-command disintegrates pretty fast among Green Berets and the SAS, when in combat -- they are expected to know their jobs, and how it fits with the whole. Of course Green Berets have to pass an IQ test, and I would suspect the SAS candidates likewise.

I'm not sure how much opinion a Colonel would want from the average infantryman. As one regular Army officer told me, "Fully 30 percent of the enlisted men have brains." But which 30 percent? That 30 percent gets so adept at pretending to be dumb!

12:33) 06-FEB-2003 18:19 Jim W. Lai

That points to a real crisis. "Dumb" occupations will tend to be automated away.

Schwerpunkt, coined by Clausewitz, translates as "center of gravity" or "focus of effort". Unity of intention. Even if command and control breaks down, the individual units know the objective and adapt to meet it. Network warfare will allow units to collaborate in new ways. Traditional command and control may be tempted to micromanage with the new tools rather than permit such alterations of structure.

A lot of processes in the business and civil domains will no doubt potentially benefit from technologies which enable alternate forms of cooperation. Email is an extant example, and instant messaging appears to be another one.

12:34) 06-FEB-2003 18:37 Nicholas Carroll

Edmonton sci-fi writer Gordon Dickson has quite a bit of nascent thinking about the future of command structures and the need for full information at every level of command in his "Dorsai" novels. Never had enough detail to sink my teeth into, though.

Histories of 1800s mountain men intrigued me in that they would operate with virtually *no* chain of command when fighting native tribes en masse; masters at survival, each knew precisely what the others would do. This system did not work so well when mountain man Kit Carson was made a Colonel in the U.S. Army, and would issue orders like "Send a few men over thar," with the expectation that they already knew what needed to be done.

12:35) 06-FEB-2003 22:07 Raymond Bouchard

If Clausewitz were alive today he would likely try to estimate the half life of *schwerpunkt*. I.e. how fast does unity of intention decay after command and control have vanished.

12:36) 06-FEB-2003 23:12 Jim W. Lai

Perhaps a better model might be phase change. Minimum thresholds for *schwerpunkt* to manifest.

12:37) 06-FEB-2003 23:37 Nicholas Carroll

I think you gents just like the word "*schwerpunkt*."

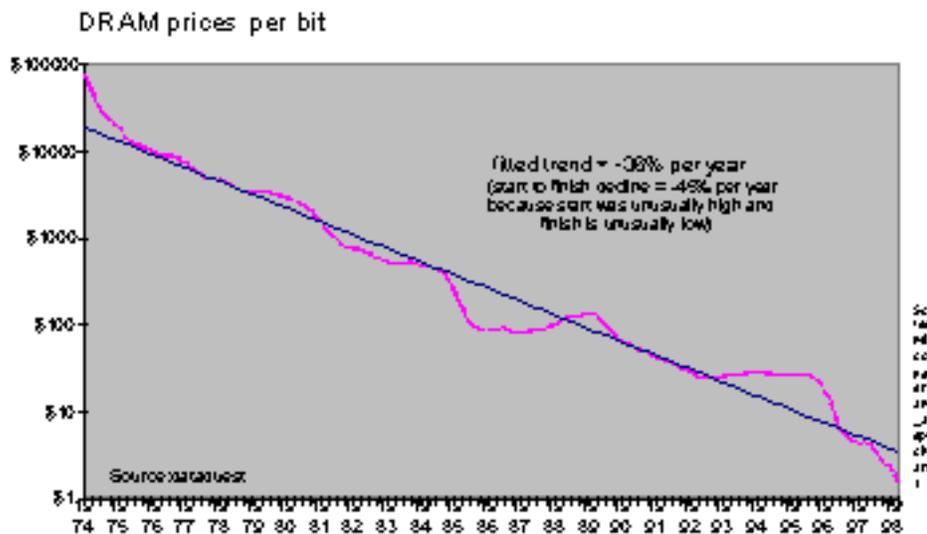
12:38) 07-FEB-2003 01:26 Hervey Gibson

Here are some takes on Moya's starting points:

1: Costs will crash ...

Two takes on this, one on declining costs relevant to nanotech and one on rising costs relevant to biotech.

First take on declining costs is a version of a famous 'cost crash' graph. '**Moore's Law**' as expressed by Moore is about the number of transistors on a chip doubling every eighteen months or so. This is it in cost terms, showing phenomenal reductions which have fuelled a significant economic growth acceleration in the US and elsewhere (See Dale W Jorgensen for discussion of the consequences)

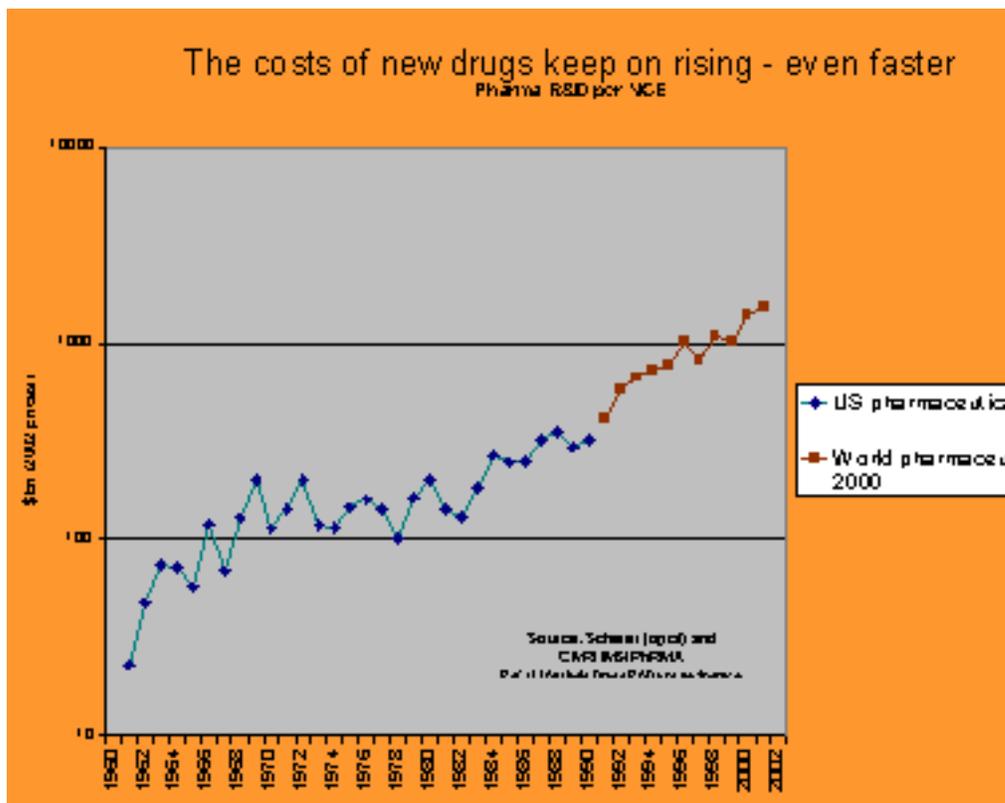


The above image shows dram prices per bit dropping from \$100 000 in 1974 to \$1 in 1998 - now around 10 cents.

Two interesting things are the way that supposed 'absolute physical barriers' have turned into surmountable fences as they've been approached and, for me, that you actually get a better statistical explanation of the cost decline if you look at it as an experience or learning curve, rather than a time trend – ie the cost reduction depends not on the passage of eighteen months, but how much the world learns from making chips over those eighteen months. If the sales/production of chips slow, then the learning slows, and the cost reductions slow, so there is a circle of causality.

Second take on rising costs shows the cost of discovering a new chemical entity approved by the US FDA or equivalent:

This image shows the costs of researching a new chemical entity rising from \$20 mn in 1961 to \$1.5 bn this year:



I hypothesise that the new phenomena that may be going on here are (1) higher and higher standards as to what is an acceptable drug and how to test it and (2) 'exhaustion of reserves' in that there is not an infinity of drugs to discover and the easier cheaper ones got found first. (There are models in mineral exploration that fit this)

3: A 24-7 world

The WORLD always has been 24-7: its just that with better comms and better memory we're now able to access what's going on in other time zones more easily. (I am writing this at 0535h Scottish Time on Friday, and it's still Thursday in Vancouver)

12: Venture capital, government and opportunities

My view based on observing biotech companies is that it's a question of two hits and you're out.

VC is always a gamble. In many high-tech areas the odds are stacked against an individual project. Organisations have to have a portfolio of projects, but a small one to provide a genuinely creative environment – say 4-5 projects max. VCs have to choose whether to back an organisation based on faith in its management and its technologies. Once two projects have failed then the rational (but grossly unfair) deduction of the investor is that it probably has not backed a winning combination – so shut down or merge the organisation. This applies not only to VCs putting capital in but also to other stakeholders like employees and conceivably even national research councils. (e-mail me at hervey.gibson@cogentsi.com for a slightly more formal Bayesian take on this argument).

Governments should be able to concentrate on spreading risks more than VCs. This also affects Moya's point 18 on partnering.

16: First big profit opportunity will be B2B

The problem with business as a customer is that it has too much buying power, and that if it thinks someone has found it to be a 'big profit opportunity' then it is too easy to enter the market itself. Consumers, in comparison, have difficulty marshalling their collective buying power and almost no possibility of entering the market.

The main advantage of business as a customer is that there are many fewer businesses than consumers, so that the cost of the development is lower. So the best substantial opportunities may be B2B but they won't be huge profit spinners.

Observation: Pharma companies make a lot more profit than Biotech!

Question: does anyone know how much Microsoft makes out of businesses as opposed to individuals?

12:39) 10-FEB-2003 15:11 Bob Watson

Dunno that, but I've read that the largest portion, by far, is from business.

Here's something apropos the topic, from the *New York Times*: [Scientists of Very Small Draw Disciplines Together](#)

The *NY Times* requires (free) registration, but here's a snippet:

The organizers believe that there are potentially large benefits to nanotechnology, which focuses on materials and processes with dimensions so small they are affected by the behavior of individual atoms and molecules. But they say the greatest opportunities lie in bridging the gaps between the rapidly growing ranks of nanoengineers and researchers in other fields — professionals who often use such different terms to describe their work that their common interests go unnoticed.

For instance, nanotechnology researchers suspect that the natural world's ability to assemble atoms into complex tissues with very exact specifications may hold the key to making vast quantities of minute, inexpensive pollution sensors or solar cells. Bioengineers, on the other hand, are looking to artificial nanostructures as possible drug delivery systems or as scaffolds to help injured organs repair themselves.

Such convergence was given a name late in 2001: NBIC, for nanotechnology, biotechnology, information technology and cognitive science. The concept is new enough that researchers have not

yet agreed on a pronunciation for the acronym. Some say "EN-bick"; some say "NIB-bick."

Nrc Technology Foresight Workshop Item 12

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)**12**[13](#)[14](#)[15](#)[16](#)

Nrc Technology Foresight Workshop Item 13

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)**13**[14](#)[15](#)[16](#)

Brainstorm Session One: Fuel Cells

Item 13 07-FEB-2003 20:32 Moya K. Mason

This week the two foresight topics have introduced a wide range of prospective technology candidates that could be considered significant, disruptive or broadly transformative if their future development and acceptance begins to shift the ways that societal capital in its various forms (e.g. 1. natural capital of environment and resources; 2. social capital of communities and organizations; 3. intellectual capital developed by individuals and teams through tacit knowledge; physical capital of infrastructure and shared facilities and innovation capital relating to intellectual property and codified knowledge) is created, managed, preserved or enhanced.

So to pursue this discussion further until February 10, we would like to focus on two specific examples of technologies that some believe may effect significance, disruption or transformation prospects and characteristics. For each of these we would like to have your ideas about how, where and with what impacts such technological developments could or might occur between now and 2025.

The idea is simple: no rules, no worries about scientific details. Let's play a game of "*what if?*" to imagine the consequences, both good and bad. Emphasis on creativity and curiosity.

We are creating separate items for each of the two technologies.

Technology #1:

Fuel cells for widespread power, transportation and energy services needs - principally hydrogen based, but also inclusive of other chemical compositions if applicable.

13:1) 07-FEB-2003 22:49 Adam L. Gruen

Can we talk about rechargeable lithium ion polymerized batteries too? Or do we have to restrict ourselves to hydrogen cells? Because making hydrogen, not to mention storing it and transporting it, is a pain in the buttocks.

13:2) 07-FEB-2003 23:04 Louis Atkinson

I'll take "inclusive of other chemical compositions if applicable" liberally, and, regressing back to "internal combustion", - BUT - combustibles that can be stored/installed in a cell:

- A shape-memory material that would explode when sparked, but would then go back into its original form. It could be used to drive pistons without exhaust.
 - A nano-material designed to do a similar thing.
 - Pistons made out of a shape-memory metal that could change shape when effected (e.g. - sparked), and then immediately return to the "down" position.
-

13:3) 07-FEB-2003 23:08 Jim W. Lai

This piece is effectively a precis of near-future successors to current Li ion battery tech. I'll quote the most interesting bit. Nanotech may play a role, as well as hydrogen.

<http://wireless.iop.org/articles/feature/2/10/4/1>

Zinc Matrix Power of the US has replaced lithium with silver and zinc in its Silver Polymer battery, which was released in June. The energy-to-weight ratio is comparable to that of lithium-ion batteries, but, because the silver and zinc reactants are far denser than lithium and graphite the battery provides much more energy for a given volume. The company's best value revealed so far is 2 kWh/l, which is about 10 times the volumetric energy density of current lithium-ion batteries.

Today much of the effort to create the ultimate mobile phone battery is devoted to R&D into polymer-electrolyte technology. Polymer electrolytes (salts dissolved in a gelatinous polymer) have been known to chemists for more than 25 years. Most R&D has focused on amorphous materials, but chemist Peter Bruce has demonstrated that, contrary to popular belief, ionic conductivity can also occur in crystalline polymers. Bruce, who is a professor of chemistry at St Andrews University, UK, has also shown that the ionic conductivity of crystalline materials can be much higher than that of amorphous materials. This introduces the possibility of using crystalline polymers to increase the energy density of polymer-based batteries, including those that employ lithium.

Increasing polymer charge densities is just one avenue open to researchers. Jean-Marie Tarascon and colleagues at the Jules Verne University in France revealed last year that transition-metal oxide nanoparticles can modify the underlying mechanism of lithium-

ion mobility. This discovery could lead to the development of batteries that have increased resistance to the deterioration caused by constant discharging and recharging.

Further in the future, handset-battery makers may dispense with toxic lithium ions in favour of highly mobile positive hydrogen ions (protons). NEC of Japan recently unveiled the world's first proton-polymer battery. The company says that the battery has "the highest capacity of any electrochemical device in the world". Unlike conventional batteries, the NEC device takes just five minutes to recharge. The company is now producing proton-polymer batteries that are as small as a credit card, which suggests that the technology can be used in mobile phones.

13:4) 08-FEB-2003 00:10 Louis Atkinson

*What if...*we could make space elevators: add Bussard ramjet wings to the ends and harvest interstellar hydrogen as the earth/solsystem/galaxy spins.

Also, wasn't there a discovery a few years back that green algae "exhales" hydrogen rather than oxygen when deprived of a certain enviromental variable?

13:5) 08-FEB-2003 01:46 Jim W. Lai

Wouldn't hydrogen from the solar wind be more dense than interstellar hydrogen for the near-earth region? We'd have to take care not to disrupt the Van Allen belts.

13:6) 08-FEB-2003 01:59 Robert Crosby

Oh perfect!

I was looking for an appropriate place to drop this idea, and this looks like it. Nathan Lamothe is a high school science teacher who lives in Saskatchewan (heart of grain belt, currently in economic crisis). A while back, he emailed me with a most interesting idea that he and his grade 12 science students came up with. In a nutshell:

"...If the farmer removes all the crop residue along with the crop, and uses it as feedstock for an anaerobic digester, the digester will produce methane gas which can be decomposed thermally into a high quality carbon black and hydrogen. The hydrogen can be used to fuel all the farms energy needs safely and cleanly. The carbon can be sold. The heat for thermal decomposition can be produced with an inexpensive solar furnace. The sludge from the digester is returned to the field as fertilizer but can have nutrients added as necessary and under ideal conditions before spreading on the fields."

Additional details, links to references and preliminary economic calculations are available in the

original, posted [here](#).

13:7) 08-FEB-2003 07:42 Dirk Flinthart

Recap from elsewhere: assuming a fuel cell with a decent storage density and a relatively inexpensive manufacture, I would expect to see standardization and interchangeability, as with batteries today. However, that has a very different meaning when you're talking about a device which has the potential to push a car along a road.

An interchangeable fuel cell with that kind of power... you would certainly see people manufacturing whitegoods to utilize such cells in places where supply of electricity was uncertain or uneven. In short order, you will also find people manufacturing recharge systems for such cells -- small solar units, or small wind generators like those on yachts.

The independent-minded wilderness dweller sets aside a small area, and "farms" his fuel cells. Maybe he owns twenty or thirty. At any one time, ten of them are in use. The rest of them are sitting on a platform, sucking up the sunlight, or drawing down ergs from the wind. Changing them over as necessary is a pain in the ass, of course. Hmm. Maybe the household supply cells would simply connect to a cable from their platform. You'd just move the connections around as your various cells ran down. Could probably automate the process.

You're not going to produce an awful *lot* of power, but if you are constantly recharging, and you use low-voltage home systems, you could sure put a dent in your grid requirements.

The interchangeability thing also solves issues of refuelling in fuel-cell vehicles. Instead of pulling into a station and pumping your cells full of fresh hydrogen, you pull into a station and exchange the dead cells in your car for live cells, leaving your old ones behind. The station recharges them under safe conditions and hands them on to the next driver.

This scenario points to a boom industry in producing small, trickle-recharge units that draw on renewable power sources such as solar, and wind. Umm... since we're talking Canada, does anybody know whether there's any value to be had from something like a thermocouple system? You know: copper and iron wires or rods together, drilled down into the ground far enough to get a few degrees temperature rise, while the other end sits on the top in a snowy winter. Ought to be able to do something with that much temperature differential, no?

13:8) 08-FEB-2003 08:32 Phil Staal

Re: any value to be had from something like a thermocouple system?

Probably too little energy available for the cost to install a system using thermocouples. You need to tap a large volume of ground, and the grade of energy is more suited to heating systems (e.g. heat pumps etc.).

13:9) 08-FEB-2003 13:01 Robert Crosby
re Thermocouples, the short answer is no, Dirk.

Looking up Type J reference table (Iron vs Copper-Nickel), for example, the voltage generated at 0degF is 0.885 millivolts. At 1,000 degF it is 29.515 mV. This means that, if you can maintain a delta Tee of 1,000 degF (which is no mean feat in itself), you can generate $29.515 - 0.885 = 28.63$ mV, or about .03 volts per junction.

[Thermoelectric generators](#), otoh (similar to thermocouples, but use doped semiconductor material instead of dissimilar metals) can generate an order of magnitude more voltage per junction, but still operate at about 2-3% efficiency.

And then there are nanodiode arrays, the invention [patented](#) by our own Charles Macgregor Brown. (To view patent, enter **3890161** in the box. Then on the next page that comes up, click "Images".) He has demonstrated that carbon nanotubes can act as diodes, rectifying [Johnson noise](#).

Even if each junction produces only a few millionths of a volt, if you can find a feasible way to electrically connect a few billion of them together in a vast array, you might have something.

13:10) 09-FEB-2003 06:49 Dirk Flinthart

Hmm. Okay, thanks for the info. This isn't my end of science, so I'm likely to need pointers like that.

Just a refresher on what we're doing, for possible latecomers -- or people like me who get distracted by drift.

%The idea is simple: no rules, no worries about scientific details. Let's play a game of "what if?" to imagine the consequences, both good and bad. Emphasis on creativity and curiosity.

Technology #1:

Fuel cells for widespread power, transportation and energy services needs - principally hydrogen based, but also inclusive of other chemical compositions if applicable.

Okay. Economic shift, and a big one. Oil-rich countries will lose the whip hand. Not only that, but countries which are early to move into renewables that can provide a steady supply of hydrogen for the cells are going to do well. Likewise, countries well positioned with renewables will have big advantages.

Example: Australia. With a massive solar resource in the centre of the continent, and an enormous coastline from which to harvest wind power, this nation of 20 million is possibly the best positioned in the world to move through to a fuel cell economy.

However: countries with a high petrochemical dependence which do NOT possess sufficient renewable supplies to meet their energy demand are going to have troubles. The USA is a major case in point. Japan is another.

For the USA, making the transition from a petrochem economy to a hydrogen economy is going to be a nightmare. Very simply: the energy density of oil is so extraordinarily high, and its availability to the USA has been such that American citizens accept without thought a per-capita energy usage that quite literally beggars a significant proportion of the world.

No matter how efficient fuel cells become, matching the availability and energy density of oil -- producing enough hydrogen from renewable resources to match the current level of expenditure -- is going to take an almost unthinkable shift in the technological paradigm of the USA. Leaving aside cultural questions (will their population put up with the massive shortages and reduced expectations? How will the 'losers' in the game, living in an already highly stratified society, deal with being 'locked out' even further than they already are?) I sincerely can see no way that the US can make that technological shift in time to beat the ending of the feasibly exploitable petrochemical supply.

I do actually have a nasty suspicion that the high end of the US government has already thought about this. After all, I don't think they're stupid, and the writing is on the wall. It would explain their efforts to acquire a controlling interest in the Iraqi reserves -- an explanation which goes further than simple greed.

It would also explain the rhetoric of an "unending war". During wartime, it's easy to convince your population to make sacrifices -- and sacrifices will have to be made as cheap energy disappears. It is also easier, during wartime, to convince your population to accept tight, military-style control: the kind of thing which will be very helpful if a significant fraction of the population, disenfranchised by the disappearance of oil, chooses not to co-operate.

In any case: assuming the emergence of high-density, low cost fuel cell technology, a country which positions itself to eke out its oil supplies to support a high-consumption way of life is buying into massive trouble. The message for Canada would seem clear enough -- work on renewable energy resources to back up these fuel cells. Be prepared to release Canadian oil reserves to a militaristically controlled, militarily overwhelming neighbour in order to buy time. Try to exact a reasonable price for these reserves, but keep a good face on it. And move quickly to implement the new technologies, to be in a position to offer assistance to countries which may be too slow to make the transition, but may retain enough military might to be a real threat.

13:11) 09-FEB-2003 09:03 Jack Smith

One of the more intriguing aspects of any fuel cell- lithium or similar battery style based energy infrastructure could be its relative mobility-portability attributes. Imagine a society where there would be more cascading, cogeneration and matching of energy service requirements to appropriate sourcing implying a much more intelligent mixing of fuel and power alignments - and where most small power needs for personal use machines, lighting etc. could be met by persons or vehicles carrying their own in belts, small packs or connectors to local small scale distributors.

13:12) 09-FEB-2003 11:22 Phil Staal

Following Jack's thoughts, such a distributed power system has a number of interesting characteristics. Instead of generation load-handling by bringing on line non-optimum power plants (e.g. coal or oil fired), and instead of having to create capabilities such as large scale hydro pumping energy storage, we could use the distributed energy storage devices and distributed generation capabilities. It's a little bit like hybrid vehicles that are becoming available. Power can be generated at a steady, efficient rate, and smoothed using the many power storage/generation nodes of the power grid. Peak loads on transmission lines could be reduced. Single point failures could be reduced. A distributed power system would be much less vulnerable to ice-storms or terrorist attacks.

The amount of power that a typical household needs to be secure is often significantly less than normally used. For example, I could get by for a long time with just enough power to run my furnace, a few lights, and my computer. I could alternate the furnace with a microwave oven occasionally. Hence, if local power storage/generation capacity were just enough to provide this minimal power, security would be far higher than the current system (no pun intended) of either full power or no power.

13:13) 09-FEB-2003 15:50 Robert Crosby

Right on, Phil. In fact, you are describing typical usage patterns in existing off-grid houses. But, unless the whole house is designed for it, it is also a royal pain in the ass, done only out of absolute necessity in an emergency. Adopting fuel-cell (or any other decentralized -- i.e. far less energy-dense) technology will both trigger and require systemic design changes, in a self-reinforcing positive feedback loop. Otherwise it is like putting sails on a tugboat.

btw, I have lived for the last 15 years in a house, in southcentral Alaska, that embodies said principles. (e.g. the closed water system functions as a circulatory system, providing thermal mass, nutrient transport, waste removal, homeostasis. Air for the aerobic waste disposal system is also an integral part of the (exhaust side) of a whole house ventilation system. soil & sand/gravel in the sunspace function as thermal mass, plant growing medium and water filter. All energy required to heat domestic hot water stays in the envelope contributing to space heat load, and is reduced to start with, because the water temp entering the heater is about 30 degF warmer than it would be if it came from a well. etc. etc.) (More details available at <http://biorealis.com/bioshelter/BioshelterNarr.html>) As it stands, this house is a far better candidate for on-site generation than any of the other houses in the neighborhood.

To be successful, such integrated systems will require a shift in thinking from conventional, specialized, discipline-specific design, where thermal envelope, mass, power, heat, light, water & waste disposal systems are all designed in relative isolation from each other, to consideration of each as components of an integrated whole system. The resulting synergies and design feedback loops are precisely what makes the [Hypercar](#) (of which today's hybrid cars are only the first step in a long transition) so efficient: (e.g. better aerodynamics means smaller engine required, which means lighter weight and smaller frontal area which makes it easier to make more aerodynamic, etc., round the loop)

13:14) 09-FEB-2003 17:02 Phil Staal

I was wondering about the "...unless the whole house is designed for it..." issue. In thinking of new, disruptive, changes, futuristic, etc. we presumably also consider those things that are unlikely to change in the time frame of interest. As an "owner" of a typical middleclass mass-produced house that I'll be lucky to pay off before 2025 or death (whichever comes first), I doubt that there's much chance of my being able to have a house of truly revolutionary design. Probably the vast majority of housing in the foreseeable future will be little changed from what exists now, unless there is a catastrophe. If housing is little changed, then successful technological changes related to housing will need to be able to be efficiently retrofitted to existing types of housing.

After the 1973 "energy crisis" we were reasonably successful in reducing energy needs with better insulation, better windows, and some learning about condensation problems, etc. However, we didn't see truly revolutionary housing become popular (passive solar etc. like Robert's place), probably because energy didn't become sufficiently expensive to make it attractive enough. In the future, if the cost/benefit changes, then revolutionary housing will probably become popular. However, we will probably also still be left with a large part of the housing that will need to be retrofitted.

Perhaps a mass-produced retrofit kit kind of like adding air conditioning to a standard house. Some sort of box/shed dropped off a truck at the back of a house that would be connected to the various house systems. Whatever the box/shed contains, it would probably have to cost no more than about a quarter the cost of the house. I wonder what a retrofit kit would consist of?

13:15) 09-FEB-2003 17:16 Robert Crosby

Something like this "[Infrastructure on a Skid](#)", perhaps?

13:16) 09-FEB-2003 17:35 Phil Staal

Looks pretty good! I suppose there would be some differences for a typical urban environment (e.g. maybe no sewage treatment, but possibly heat recovery of wastewater). Maybe these units would be networked and talk to each other to perform better as a system? and the diesel generators could be replaced by solar cells and perhaps fuel cells running off the local fuel network (it's natural gas in my neighborhood at the moment)...

13:17) 09-FEB-2003 20:52 Robert Crosby

Yes. These units, as described, are designed for use in rural Alaska (or Canada?) where no existing infrastructure exists and where #2 diesel is the most dense energy source available. Temporary camps for, e.g., remote construction, exploration, or scientific purposes are another viable market. But the general design principles could be applied to other markets.

Right now, though, I don't see much of a market in the 'developed' world for anything like this until either (1) the existing infrastructure begins to visibly fail, and/or (2) some technological breakthrough(s) bring costs down to where it would be in the average homeowner's economic self-interest to replace their existing system. At present, I don't believe those curves are anywhere near to crossing. Perhaps an even bigger hurdle to overcome is 'systemic inertia' -- i.e. the reason there is no market for Segway scooters in San Francisco.

Having said that, I'd like to point again to (what appears to be) a very interesting idea for how to initiate the transition to a hydrogen economy, while at the same time opening up new markets and opportunities for Canada's beleaguered grain farmers using a large existing unutilized source of biomass -- straw & chaff. Given the lack of response to [Item 13:6](#) above, I'm not sure if anyone followed the link, or really read the details, or if it just wasn't worthy of response. At any rate, here it is again: <http://www.biorealis.com/Forum/noncgi/Forum3/HTML/000013.html> -- IMO, worth at least a careful review.

13:18) 09-FEB-2003 22:34 Phil Staal

I recall seeing a documentary showing small scale digesters being produced in India with the help of some organization like the Peace Corps -- they seemed to be effective.

13:19) 10-FEB-2003 01:27 Robert Crosby

Yes, anaerobic digestion is well established, applied in many shapes & sizes all over the world. But please note that that is not what is being proposed here. Or rather, that it is only one component of a much bigger, much more comprehensive idea.

The methane (CH₄) thus produced is decomposed into hydrogen and carbon black, both of which are marketable (as well as the CO₂ credits from the sequestered carbon). And at far lower energy cost than electrolysis of water (which, IMO, is a ludicrous idea once you look at the thermodynamics).

Links to a number of technical references are provided (i.e. from the economics of harvesting the ag residue, to research papers on the economics of using hi-temp focusing solar collectors to decompose the CH₄) as well as preliminary economic analysis. Until someone points out the flaws in it, it seems to me to be a great idea! Please take the time to look at it!

13:20) 10-FEB-2003 10:08 Phil Staal

Is it easier to decompose the methane first, then use a hydrogen fuel cell, or use a methane fuel cell then deal with the byproducts?

13:21) 10-FEB-2003 10:22 Bob Watson

I'm glad you mentioned methane fuel cells, Phil. High latitude countries like Canada have methane hydrates buried under permafrost -- if there's a way to get these to market it would be a great boost for fuel cell use.

I'm no mechanical or chemical engineer, but perhaps something as simple as an insulated dome covered with black (light/heat absorbing) plastic on the south side would melt the permafrost and make access possible (plus serving as a temporary collection device).

13:22) 10-FEB-2003 11:36 Louis Atkinson

As an aside, Robert mentioned at response 17 that "I don't see much of a market in the 'developed' world for anything like this".

It turns out that in the U.S. Deep South (TX/LA/MS) with the changes in architecture over the last century due to air conditioning, that black mold is running rampant in the hot and humid environment. Insurance companies are no longer covering mold damage because of overwhelming medical and homeowners claims. In many cases it is easier and cheaper to rebuild (I know someone outside Dallas currently rebuilding using wall panels made by a German ceramics co.) rather than clean it out, since the mold can grow into wood, brick, and concrete.

That is, "(1) the existing infrastructure -is beginning- to visibly fail".

13:23) 10-FEB-2003 11:36 Robert Crosby

[slipped Louis]

I suppose that will depend on the development of the respective fuel-cell technologies, Phil.

But there may be other reasons to decompose it first: 1) to initiate and support the transition to a H₂ economy (every farm a H₂ fueling station?), and 2) to sequester the carbon, which will not only *not add* to atmospheric CO₂, but actually will *remove* a significant source. There is also a commercial market for high quality carbon black (e.g. inks, rubber, cosmetics, buckyballs, etc.), and the CO₂ credits can be sold (per Kyoto agreement).

Bob, the methane hydrates encapsulated in permafrost and at the bottom of the sea is a huge new source of additional global warming. I think it not unlikely that, as global warming continues, it will be (is being) released in ever greater quantities already, leading to a thermal runaway condition. Where the warmer it gets the more is released and the more is released, the warmer it gets.

13:24) 10-FEB-2003 11:50 Bob Watson

Robert, I've understood that -- so I guess the question will be one of economics and control. Having a million farmers creating a more-or-less local market for H2 is philosophically attractive, but I dunno if it will attract the investment needed to create a marketplace.

I think the methane emission issue can be (or will be, take your pick) seen as a impediment rather than a stopper. Maybe fuel-cells will be handled like glass bottles used to be, reused and refilled at a central site with the tech needed to handle the problem.

Maybe.

13:25) 10-FEB-2003 12:22 Robert Crosby

Those are good points, Bob. In fact 'economics and control' will trump 'philosophically attractive' every time.

But I don't see it as just 'philosophically attractive', nor even just 'local market'. As envisioned (assuming the details pencil out) I think it could be better characterized as 'long range planning'. So maybe the problem can be more accurately stated as "short term profit will trump long range planning every time".

We need to figure out ways to initiate the transition to a hydrogen economy well before the rising costs of fossil fuels makes it necessary. Or are you suggesting forgetting the H2 economy idea entirely, in favor of developing and exploiting new sources of fossil fuel, e.g. methane hydrates.

13:26) 10-FEB-2003 12:32 Bob Watson

I'm not really suggesting the latter -- I was working off the "methane fuel cell" idea mentioned prior. I'm willing to bet, though, that the oil biz wants methane distributed according to its existing model (fueling stations). I'd much prefer distribution for direct electricity conversion (maybe similar to how propane is sold, in smallish tanks).

13:27) 10-FEB-2003 13:56 Burl Grey

I have an interesting and amusing essay from the First World Hydrogen Conference in [1976](#).

I was a card-carrying member of the organization after reading "The solar Hydrogen Alternative" in 197? by John O'M. Bockris.

13:28) 10-FEB-2003 17:16 Robert Crosby

A lot of the information about Hydrogen, and energy in general, is commercial hype, ignorant at best, deliberate misinformation at worst. Here are some links to sources of *good* information, useful for evaluating the claims. From <http://www.dieoff.org/synopsis.htm>, referring to "Emergy" concepts described in [Environmental Accounting: Emergy and Environmental Decision Making](#) by H.T. Odum:

"A BTU of sunlight is fundamentally different than a BTU of fossil fuel. Directly and indirectly it takes about 1,000 kilocal of sunlight to make a kilocalorie of organic matter, about 40,000 to make a kilocalorie of coal, about 170,000 kilocal to make a kilocalorie of electrical power, and 10 million or more to support a typical kilocalorie of human service. So when renewable energy systems are evaluated, both inputs and outputs must be converted to solar eMjoules (or "sej") and compared. (There are ten different sets of equations to convert energy to sej: <http://dieoff.com/emergy.pdf>) The difference between the sej input and sej output is known as the "net sej".

Calculations show that solar cells consume twice as much sej as they produce. <http://dieoff.com/pv.htm>. So even if all the energy produced were put back into production, then one could build only half as many cells each generation -- they are not sustainable. Even if the sej efficiency of solar cells doubled, ALL of the energy produced would have to be used to manufacture new cells, which still leaves a zero net benefit to society!

Traditional measures of "net energy" for solar cells may be improving but "net sej" may be getting worse because there are ten different sets of equations to convert energy to sej. The only way to know is to DO THE MATH. <http://dieoff.com/emergy.pdf>

H.T. Odum's solar "eMerger" (eMbodied energy) measures all of the energy (adjusted for quality) that went into the production of a product. Odum's calculations show that the only forms of alternative energy that can survive the exhaustion of fossil fuel are muscle, burning biomass (wood, animal dung, or peat), hydroelectric, geothermal in volcanic areas, and some wind electrical generation. Nuclear power could be viable if one could overcome the shortage of fuel. No other alternatives (e.g., solar voltaic) produce a large enough net sej to be sustainable. In short, there is no way out.

The fact that our society can not survive on alternative energy should come as no surprise, because only an idiot would believe that windmills and solar panels can run bulldozers, elevators, steel mills, glass factories, electric heat, air conditioning, aircraft, automobiles, etc., AND still have enough energy left over to support a corrupt political system, armies, etc."

For less technical (but still rigorous) info, see Don Lancaster's ["It's a Gas" Hydrogen Library](#) for a

wealth of information, from energy fundamentals to batteries, to carbon nanotubes, to electric vehicles, to fuel cells, to hydrogen, to hydrates, to hybrid cars, to....

13:29) 10-FEB-2003 18:04 Phil Staal

Cost of production and low efficiency have indeed limited the usefulness of solar cells. Nevertheless there are some applications where solar cells are quite practical. Direct production of electricity from sunlight is very useful, but of course it won't solve our energy needs with present cell design. ...oops -- gotta go -- I was just called for supper...

13:30) 10-FEB-2003 19:02 Robert Crosby

True. There are, and will always be niche markets.

To me, Odum, Lancaster, et al, provide the theoretical basis for better understanding on a global scale, necessary to be able to critically examine claims like "renewable" or "sustainable", and hopefully, to dispel some of the widespread myths. A lot of what I read (and hear, e.g. from our president in his recent State of the Union address) is just plain wrong.

Nrc Technology Foresight Workshop Item 13

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Nrc Technology Foresight Workshop Item 14

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)**[14](#)**[15](#)[16](#)

Brainstorm Session Two: Biosensors

Item 14 07-FEB-2003 20:53 Moya K. Mason

This week the two foresight topics have introduced a wide range of prospective technology candidates that could be considered significant, disruptive or broadly transformative if their future development and acceptance begins to shift the ways that societal capital in its various forms (e.g. 1. natural capital of environment and resources; 2. social capital of communities and organizations; 3. intellectual capital developed by individuals and teams through tacit knowledge; physical capital of infrastructure and shared facilities and innovation capital relating to intellectual property and codified knowledge) is created, managed, preserved or enhanced.

So to pursue this discussion further until February 10, we would like to focus on two specific examples of technologies that some believe may effect significance, disruption or transformation prospects and characteristics. For each of these we would like to have your ideas about how, where and with what impacts such technological developments could or might occur between now and 2025.

The idea is simple: no rules, no worries about scientific details. Let's play a game of "*what if?*" to imagine the consequences, both good and bad. Emphasis on creativity and curiosity.

We are creating separate items for each of the two technologies.

Technology #2:

Biosensors, genomics data and their connections into smart, sentient and functionally enabled networks, including geo-spatial data so that personal and population health, disease, societal resource uses and pollution problems and opportunities could be affected or more effectively managed.

14:1) 08-FEB-2003 08:00 Dirk Flinthart

Hmm. The 'good' applications are obvious. What about the nasty ones? The sensor systems that the courts stick onto sex offenders to monitor their physical status at all times, for example. Thou Shalt Not Be Aroused Inappropriately -- because we'll know about it, buster.

Worse: use of biosensors to monitor emotional and psychological status of people in public places, 'for the public good'. If we can incorporate such sensors into clothing, or mobile phones or the like, it becomes pretty easy to ensure that everybody behaves.

I could see such sensors being used at demonstrations and protests: once too many people got excitable, there would follow a release of tranquillizers into the air.

Sentient networks are always a bugger to contemplate. I mean, if they're sentient, can we actually make them smarter than we are? And if we do, shouldn't they be in charge? Can we trust them if they are? How much responsibility do we cede to artificial intelligences?

Let's suppose they are sentient. That they are smart as hell. That they are even altruistic. Okay -- I don't suppose I can think that way. But my best efforts envision a kind of zookeeper mentality: monitor and control of a populace which doesn't know it is being monitored and controlled for its own good.

It's an interesting question to consider. Supposing such sentient networks could exist, with the data resources and even physical resources of the world largely within their capacity to command... assuming they were altruistic enough to want to keep humanity around, they'd have to keep themselves largely secret. That wouldn't be too hard, really. As somebody put it a while back: on the Internet, nobody knows you're a dog. It would be easy for a powerful AI to pretend as many real-world identities as it needed.

Hmm. Is anybody absolutely sure it hasn't happened already?

Woof! Woof!

14:2) 08-FEB-2003 13:26 Robert Crosby

Yeah. The suggestion that it would be possible for individuals (or gov't agencies, for that matter) to manage or control a 'sentient network' of which we are a part, reflects a world view that, IMO, is just wrong.

About as likely as one of the 'dumb agents' that make up a '[Society of Mind](#)' could even percieve it, let alone control it.

14:3) 09-FEB-2003 07:06 Dirk Flinthart

What do you suppose happens when two sentient networks meet up? Is there anybody here with a serious jones for Game Theory? I mean -- you're an AI, massively powerful, linked through medical databases and informed by zillions of little sensors. One day, somebody hooks a fat cable into one of your larger hardware centres, and suddenly, you become aware of another AI...

This one is all about libraries and information retrieval, or so it tells you. How powerful is it? How do you test it? Do you test it? Do you assume that its sentience resembles your own? What are its motives? Does it have motives?

This is why I want to think in terms of games theory. What's the 'best outcome' for an AI that suddenly encounters another about which it knows nothing? Are we going to see AI wars, as AIs designed and developed for different purposes, with different core systems, come into contact with each other?

Harlan Ellison decided that military AIs would probably join sides against *us*. (*I Have No Mouth And I Must Scream*)

And there's a thought for you: military AIs. You want to win a war in the most efficient fashion? Build a tactical and strategic supergenius, with an inbuilt memory of every battle every fought, and a complete sensor-picture of the ongoing battlefield, right down to the individual condition of each soldier. After all, that's the kind of capacity we're talking about here.

In fact, I think that will be one of the first places this technology emerges, if it emerges at all. We're already trying to computerize the battlefield to strip away the 'fog of war'. Anybody remember *Aliens*-- where the marines went in, and the officer sat back on the command vehicle and ran the show by wire? That's crap -- simple lag time would screw it up. But suppose you have this powerful sensor technology, and the ability to link it up. Wouldn't it make sense to use it as a kind of "nervous system" to co-ordinate your soldiers into a cohesive unit with a terrifyingly quick response time?

And of course, you can upscale that -- which is how you wind up with your big AI running one side of a war.

That brings up strange and compelling questions. Suppose: to win a major action, it is necessary to take a particular hill away from the enemy. A human commander can see this. So can the AI. The human commander is aware, however, that an assault on the hill will result in at least 80% casualties in the unit that makes the attack. The AI is also aware.

The human commander is likely to hesitate, no matter how clear his/her vision of the overall action. Recheck the data. Look again: is there any alternative? An AI can do that so quickly that it will take no time at all, and the troops will be ordered in.

How will the troops respond to that? Knowing that they're being ordered to near-certain death? Probably by a computer? What's the interface going to be? How do you ensure human loyalty to a machine intelligence?

You know, if nothing else comes of all this consideration, I'm going to walk away with a fistful of really cool storylines for future use!

14:4) 09-FEB-2003 09:11 Jack Smith

Another element of this continuum could be the application of brain scanning techniques to determine the cognitive predispositions of individuals - positively and negatively in situational stress or inclination-action sequences. Apparently the neural patterns of our brains are more revealing than we thought and so we may be forced at some time in the future to submit ourselves to these techniques - for better and/or worse and redefining what the niche of human behaviour may be within a larger context of organized management of capabilities by humans and machines.

14:5) 09-FEB-2003 19:26 Dirk Flinthart

Except, of course, that we are very unlikely to be able to develop models that incorporate high-end responses. I mean, suppose you test ten thousand people to develop your neural pattern model upon which to redefine the acceptable limits of behaviour. Did your ten thousand people include a Gandhi, a Nietzsche, a Beethoven, or a Picasso?

Probably not. Which means, of course, that the best part of what it means to be human won't show up on the model...

14:6) 09-FEB-2003 19:27 Dirk Flinthart

Meanwhile: this thought isn't just regarding biosensors, but it is about powerful sensors, near-sentient networks, and the all-important interface between the human being and one of the most important of these networked systems...

Okay.

If we've got these brilliant sensor systems that network together into sentient or near-sentient structures, you know what I want?

I want my house to be smarter.

I mean, twenty thousand years of human development, and I'm living in a wooden cave with glassed-over holes in the walls. Well yeah, the fire gets turned on and off with a knob, and I don't have to carry the water, and the light hangs around all night if I want, but it's still dumb as a post.

Smart houses have been discussed by many people, but I've yet to read a sensible version, so I'm gonna play with the idea. And for what it's worth, I had exactly the same approach to the refridgerator about eight years ago: well before there was any talk of an 'internet fridge', I was planning a fridge that would read all the bar codes on your food, remind you to buy milk and eggs, keep track of your shopping expenditures, remind you about the leftovers before they went feral, tell you about the calorie/kilojoule count of the food you were planning to eat, and maybe act as a general message bank like refridgerators have been doing since the dawn of time. (How do you suppose families communicated before the invention of the fridge, and the fridge magnet, and the post-it note?)

Of course, I thought it was too silly an idea to protect it legally...

Anyhow, here's my take on the Smart House. In actual fact, it doesn't assume a whole lotta new tech. It assumes good speech recognition, good sensors, easy networking of various devices, and most importantly, a flexible, redundant, powerful operating system that *won't die* the moment something untoward happens. Frankly, I think the Smart House will be coming out of Linux.

I wanna be able to talk to my house. I still want my desktop workspace, and a keyboard because if I talk rather than type I don't slow down enough to really construct good prose. But for dealing with my house, I want to talk, and I want to be able to do it from *every room*. I want to be sitting there on the toilet, unable to get hold of pen and paper when that brilliant idea occurs to me, and I want to be able to say "Ahab!" (Ahab is what I'm calling my Smart House.)

"Yes, Dirk?"

"Take this down, Ahab: brilliant idea for a new TV series in which evil animatronic puppets take over the world by standing in for well-known government figures, and nobody much notices except a few old puppeteers, who design shiny new animatronic heroes to battle the villains."

And Ahab puts it in a file, and the next time I sit down to write, he says: "Hey, Dirk — here's the text version of that brilliant idea you had on the toilet." And then he shuts up, because I don't want his opinion. I don't want to know how it would sell better if the new puppets were cheeky adolescent girls, or that I could reach the teen male market by putting in a skateboard puppet. I don't want *any* of that pro-active Microsoft crapola unless I actually ask for it.

Anywhere in the house, any time. That's how I want to be able to reach Ahab. And I want him to be smart. I want him to be able to work just about every electrical device in my house, so he can minimize my electricity expenditure. I don't want my television on "standby", sucking up power. I don't want my video player, or my DVD or my electric oven to be doing it either. I want the bastards DEAD when they're not in use. I understand that in the average household here in Australia, such a measure would reduce electricity consumption by about ten percent, and I think that's ten percent which could be put to better use elsewhere.

If Ahab controls those things, I can say: "Hey, Ahab — I want some music, mate. Gimme... ummm... the Dead Kennedys. The album with *Holiday in Cambodia* on it, okay? And make it loud.)

And I want Ahab to say: "Okay, one moment Dirk," while the stereo comes back from the dead and he figures out which album I'm talking about. Maybe he needs clarification. He asks me: "You want the album that originally released *Holiday in Cambodia*, or the best-of compilation which also contains that song?" So I tell him. And he cranks up the music.

But the music only happens in the room I'm in, because there's no point in blasting it all over the house unless I've got obnoxious house guests. And if that happens, well, I want Ahab on my side again. I want to be able to say: "Hey, Ahab — when Richards gets into the shower, I want you to randomly cycle the temperature of the water between five degrees centigrade and fifty degrees centigrade. And if he asks, tell him we've got a faulty capacitor in the water system, or something. Then shut off the shower altogether."

What else do I want from Ahab the Smart House? I want reminders. I want a calendar that talks. When I sit down for breakfast, I want to say: "Ahab — what's on the list for today?"

"Vacuum the cat, worm the children, arrange to have the car serviced, call Paul to organize a barbecue date, write a letter to Penguin Books, and remember you promised to cook Thai tonight."

"Oh, yeah. Get a shopping list together for me, will you? Send the basics through to the supermarket — milk, bread, cheese, eggs, onions, potatoes... I'll get the rest from that greengrocer place with the good vegies."

See? Ahab isn't just home-smart. He's wired into the 'Net, too. He can communicate. He's programmed so that in emergencies, he can contact the appropriate service: fire, police, or ambulance — but ONLY if nobody with appropriate authority in the house is available. Don't want him calling the fire service every time I light up a doobie.

He screens calls, too, and even answers them and takes messages. There I am, one kid racing around the house on his tricycle with a bucket on his head, making siren noises at the top of his lungs. The other kid is lying on his back with his legs in the air and i'm covered in sticky poo to the elbows as I struggle to contain the biohazard with a nappy that suddenly seems ten times too small — and it's always *right then* that the phone rings. And it's never important. It's always some prick who wants to talk aluminium siding, or my mate Andrew who wants to tell me about a car he's thinking about buyin. So instead, I say: "Ahab — get the phone. Screen, please."

And into the phone, he says: "Flinthart's place. Who's calling, please?"

Then he passes the information to me, and I decide whether to hold, or call back, or take a message, or put it through to a speaker system so I can talk while I scrape crap off the baby, or even whether to put some aluminium siding fellow on *permanent* hold with a special loop-tape of *The Girl From Ipanema* on the Hammond Organ to really trash the bastard's blood pressure.

Aside from phone calls, and calendar organization, Ahab's super-accurate internal sensor system also knows important stuff. Every time I get hold of something I really don't want to lose, I tag it with one of those microsensors. Then Ahab knows exactly where it is in the house at all times. That means I can do things like this:

"Ahab! Where are my *keys*?"

"I believe Talley took them, Dirk. You will find them shoved into the right nostril of his largest teddy bear — the one which now has a steering wheel embedded in its head."

Keys. Wallet. Shoes definitely. Remote controls? Nah. Why bother. That's what Ahab is for. "Ahab, this State of the Union speech is utter nonsense. Somebody should wipe that idiot's chin. Get me the Naked Snow Bunny Channel immediately."

I want my whole house to be smarter. I want liquid crystal sandwiched into the window glass, so that I can opaque them at a command — via Ahab, naturally. I want the hot water system regulated so that it warms up before shower time, but switches off by night when everyone is asleep. I want heat in and light in the rooms where heat and light are needed, but no expenditure of energy in the rooms which aren't being used. I want the garden plants regularly watered. I want the budget monitored, so that if we get close to a predetermined spending level, Ahab can beep me and let me know before I go crazy in the DVD section of the local department store. I want Ahab to co-ordinate the usage, emptying and recharging of the little vacuum-cleaning robots which have actually just been invented and released in this, the real world. I want him to monitor the level of the fuel cells in my car, and to take care of the recharge cycle of the house cell system using the bank of solar and wind generators on the hill above my place.

And security, too. Ahab's got all these groovy little sensors, right? So I want him to tell me when someone crosses the property line. I want him to know where they are, and if possible, who they are the moment they set foot on Flinthart turf, and I want him to keep me posted about it unless the person in question is on a short,

limited list of permanent open-house guests. (Well.. okay. It's not that short a list, even down here in Tasmania.)

Also, I don't like mosquitoes. I want Ahab to track incoming flies and mosquitoes, and put the *righteous zap* on the little buggers the moment they fly clear of household personnel, goods and chattels. Not only that, I want Ahab to keep a running tally of kills, so that I can gloat quietly to myself at the end of a long, hot, sweaty day full of bugs. Yeah. That would be *really* cool.

Just as important as what he does, there's what he doesn't do:

1) He doesn't respond in any way, shape or form to inquiries from *any* authority other than mine, and those people *specifically* authorized by me to have verbal interface with him. To change his basic programming, Ahab has to recognize a combination of DNA and complex code-word. Naturally, there has to be an emergency over-ride — but I sure want Ahab to *bellow* when it's used, to make sure I know that somebody else is messing with my house. The Narcs can go to hell. My house is *my* house, and interrogating it constitutes illegal search and seizure in a big way.

2) He doesn't tell me what I'm not interested in knowing. Oh, sure — Ahab knows the caloric content of everything that goes into or comes out of the fridge. But unless I *specifically* request him to pass me the data, he doesn't bother me with it. None of that pro-active Microsoft nonsense, thanks.

3) He doesn't *do* what I don't want him to do. He's not going to decide I'm gay because I watch *Sex and the City*, and start recording Barbara Streisand movies for me to watch. None of that pro-active Microsoft nonsense. Have I said that before? Maybe I need to say it again, to be certain.

Okay, offhand that's a reasonable description of what I want my house to be able to do. Now, here's a bit more information: I want the Ahab unit itself to be unobtrusive and out of the way. No bigger than a current home computer. I want it to run cheaply. I'm prepared to pay for the various hardware bits, of course, and I'm even prepared to pay a little bit more to make them networkable. (By the way: here's how you network a new device in a Smart House. You plug it in. You turn it on. Then you say "Hey, Ahab — new videophone installed. Get it going, will you?" Then Ahab does the rest by wireless.)

I want the thing reliable, too. And most important: I want a couple of well-placed emergency over-ride buttons. Press any of them, and the house reverts to being a dumb wooden cave instantly. I'm not getting into any B-grade horror movie battles with my own house...

14:7) 09-FEB-2003 20:34 Phil Staal

Random thoughts:

How 'bout some sort of distress sensor -- what good would voice activation be if you were choking on something? Many people are injured in their homes -- sensing distress, Ahab could do something appropriate.

There are many semi-intelligent devices in homes these days - VCRs, DVDs, phone/answering machines, microwaves. Some of them already communicate by RF. Surely the networked home is on the way. Cheap wireless reliable sensors (including biosensors) will be a key to creating Ahab, who will be the integration of the whole system. All of the capabilities Dirk lists are currently possible, just expensive and probably prone to failures. We'd need commonality for cost reduction and redundancy for reliability?

Very low-power standby mode is possible, but a bit tough if turn on is by RF...

14:8) 09-FEB-2003 21:48 Nicholas Carroll

Phil, 300 baud short-range modems are down to 5 cents.

Dirk, Ahab sounds like a PITA to me, I've had enough service! Anyway, I *like* doing thing with my hands.

The smart house does point me to another possible future, tho, under the impetus of this gathering of Big Brains. I mentioned in post 10:11 that "I think that as more channels of communication are added, humans and machines will start to "think together" to a degree unimagined today -- roughly the difference between a Neanderthal rhythmically thumping a log, and a modern symphony."

Extending that thought, I wonder if "symbiotic intelligence" won't arrive long before artificial intelligence. That is, not merely intelligence amplification or augmentation -- but a scenario in which much more sophisticated feedback loops between human and computer "teach" the computer to act in concert with the human. Ahab v.3.0?

14:9) 09-FEB-2003 22:44 Phil Staal

Before that'll be effective we need to develop much better human computer interfaces. Human computer relationships that I've generally seen have been dysfunctional and hateful (how many times have you sworn at your computer or threatened to end its existence when it has crashed?) If my computer is going to "act in concert with" me, it had better be friendly, helpful, reliable and faithful, with a great personality...

14:10) 10-FEB-2003 01:15 Nicholas Carroll

Phil, that technology is pretty well in the bag. It's a question of marketing it. Current "interface" is a farce, stuck in da Vinci's "vision is the queen of the senses", conceived by graphic designers and coders with not the faintest notion of neurology or information science. (Not that they actually know the da Vinci quote.)

As to the great personality ... well, you get what you give, if you give what you get. [Grace Slick, no?]

14:11) 10-FEB-2003 10:03 Andre Levesque

Biosensors for sensing what? On an environmental perspective, biosensors could be extremely useful to find out rapidly about problems and about the capability of the environment to "repair" itself. There are numerous examples of bioremediation and disease suppressiveness where soil microorganisms can decontaminate sites or allow crops to grow year after year without root diseases. However, very little is know about the biota profiles that are conducive to such beneficial effect. For a better management of the environment, we will need to take a step back to find out more about its biological components. Molecular characterization of all species found in Canada by sequencing a few housekeeping genes for all of them is the first step needed to develop meaningful and reliable environmental biosensors. We are far from there and monitoring the environment will not be accomplished effectively without this baseline data.

14:12) 10-FEB-2003 10:25 Raymond Bouchard

I am not too sure that I would want to live in Dirk's house. Is the end point of all this technology really that we instantly satisfy whatever random desire passes through our heads? We would go crazy at first because we would fuss over choices, given that anything is possible. It's the video store syndrome - thousands of titles yet there's nothing you want to really, really see. On the other hand, if it's too cold outside to venture to the video place we're perfectly happy to watch whatever crap is coming down the cable.

That's why people have cottages. I recall visiting some friends who had a cottage at Wasaga Beach, just north of Toronto. It was a shack plonked in the woods along with hundreds of others with only dirt roads connecting them. The kids rode their bikes and played on the 'streets'. It reminded me of a third world slum. Of course only the wealthy could afford to live there. Point is that excessive convenience quickly becomes inconvenient and people want simplicity in their lives.

14:13) 10-FEB-2003 10:28 Bob Watson

(slipped Raymond)

I imagine that one can identify *some* particular vulnerable species.

For instance -- here in Chicago we've lost 80% of our crows over the past year, due to West Nile virus. They're very susceptible.

If you tagged a number of crows with biosensors and found that many were dying w/o known cause you'd likely have warning of West Nile long before symptoms showed up in humans.

14:14) 10-FEB-2003 14:21 Jeff Butler

I live in a cottage - in the countryside in England. Horses, cats, hedgehogs and chickens, and a few people.

I also rather like the idea of living part time in Finland sometime in the future, with a private lake with an outside sauna, but I guess truly only when its warmer (climate change) and when the alcohol is less expensive. Switzerland is also of interest, and clean.

Biosensors would help me understand my moods and help me decide when I had had enough sauna and cold lake swimming, and help me do my gardening although that is minimised natural style anyway.

All this might sound small scale thinking and small scale geography to Canadians, who have ... space. But the housing land crisis and price increases and the pensions industry crisis in the UK suggest to me that my future will not be so rosy and it becomes ever more difficult to find cottages that haven't been renovated into mansions and ever more difficult to imagine how our children will have the flexibility to choose what lifestyle they might ideally like.

I hope that bio sensors don't create virtual worlds that make us believe we are where we want to be.

Already the perceived importance in business of intangibles associated with product development and delivery are causing businesses to create 'artificially' generated environments such as smells of coffee in a coffee shop when the coffee isn't strong enough or appropriate enough smell, or packaged food with E additives for flavour etc. I hope fuel cells will allow me to be where I want to be and not force or steer me to be where I don't want to be because of some 'professional' or economic reason.

I hope both biosensors and fuel cells might connect together people and ideas and imagination and fun and good design and good health and a clear conscience.

Child abuse and a few other 'bad' things have to go.

We don't seem to have a very good method of dealing with crime - we think that a period in prison has the same effect on all people whatever their backgrounds and dispositions. Our prisons are overfull. We have a political asylum and economic immigrant problem across Europe. It isn't just an administrative problem.

We don't properly know how to create effective deterrents against crime nor educate imprisoned offenders away from crime. We are playing with relatively crude electronic tags (compared with 25 years from now) that show where paroled people are geographically located.

We just tend to lock people up and when crime increases or numbers of asylum seekers increase - we propose to lock them up for longer periods. Its rather like the Englishman who does not speak any foreign language but just shouts louder, believing that he will then be understood.

But we could instead use security checking systems or punishment and rehabilitation/education systems that allow the 'tagged' people to exist in a much wider variety of geographical situations, some of which they do not like. These will be prisons that are not buildings. There would need to be some sort of biosensor enhanced tagging system that did more than informed the police their owners had gone missing. Perhaps the tagged people would find themselves in a hot sweat or a quick bout of fever.

So minimal disruption or remedial actions to improve our quality of life should be identified, not disruptive or transformative applications primarily for economic development purposes.

Italy suddenly seems attractive to me. I haven't been to Rome. I want to see the architecture.

My biosensor might remind me gently to schedule that holiday for my health benefit, instead of connecting me faster to the internet travel agent. It might help my wife and I reach a consensus on where we could go and which hotel to stay in instead of us discussing different places and then not going anywhere. Although I quite like thinking of different places even if I don't go.

So I am rambling and my moods swing. These emotions and the creativity that comes from wandering and making free associations are valuable - I enjoy creativity. I want it for its own sake - and for art and design and good living.

Technology should/can help me enjoy my old age. But I can't just think on a 25 year timescale. By 77 years age I'll definitely need the fuel cells for mobility.

I wonder if we will still have Alzheimers by then and if so, if the biosensors might help victims??

So I start people first, starting with myself and family (and animals), not technology first. But the two come together.

I hope that the diversity of cultures across Europe continues.

Surely we can use biosensors to enhance creativity sessions.

14:15) 10-FEB-2003 15:00 Jim W. Lai

I read today that in some Canadian cities and communities the drinking water was found to contain pharmaceutical traces.

<http://www.globeandmail.ca/servlet/ArticleNews/front/RTGAM/20030210/wxater0210/Front/homeBN/breakingnews>

Trace amounts of prescription drugs have been detected in the drinking water of four Canadian communities, including Montreal and Hamilton, the first time pharmaceutical products have been discovered in North America's municipal water supplies...

The tests, by Enviro-Test Laboratories of Ottawa, found the drug residues in concentrations in the 6.5- to 70-parts-per-trillion range...

Health Canada and Environment Canada are currently surveying 24 Ontario communities to check if drug residues have entered water supplies. The agencies are considering expanding their testing to the rest of Canada next year...

Drugs are entering the environment because many pharmaceuticals are not fully metabolized in the bodies of those using them...

Will biosensors have to be upgraded as new pharmaceuticals are brought into the system?

14:16) 10-FEB-2003 16:56 Burl Grey

I just read "The Killers Within: The Deadly Rise of Drug-Resistant Bacteria." and I saved an article from [1998](#) that resonates with it.

March 21, 1998

Drugged Waters.

Does it matter that pharmaceuticals are turning up in water supplies?

"Parts-per-trillion concentrations of these drugs can affect Escherichia coli and other bacteria, he notes. The 1,000 times higher concentrations reported in German wastewater suggest to Levy that these antibiotics may be present at levels of consequence to bacteria -- levels that could not only alter the ecology of the environment but also give rise to antibiotic resistance."

Nrc Foresight Workshop Item 15

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

What's Your Take?

Item 15 07-FEB-2003 21:10 Moya K. Mason

I liked what Jack said earlier today so much that I thought I would open it up for further discussion (see below). The work of trying to predict the future is not an easy one. What's Your Take? What are we missing? What needs to be in the mix? Think About the Unthinkable.

"In particular we are seeking some reference points through feedback on just how conservative, naive or adventuresome you believe we have been in attempting to ascertain what might be some of the driver technologies for 2020 that are within the imagination of the present - or for that matter outside the present paradigms and therefore in the realm of what we call wild cards.

But then who in 1980 could have imagined the connectedness and immediacy of the internet, or even in 1999, who could have imagined that the value of some prominent telecom company shares would drop below \$2 when they were moving from the steady values of \$20-30 toward \$100 and beyond - so one must also ask when making assumptions about the future- what if it is also the opposite - can the unthinkable be thought of too?"

15:1 07-FEB-2003 23:10 Nicholas Carroll

"The work of trying to predict the future is not an easy one."

No, but 90% of the time it's not all that hard, either. Few scientific innovations significantly alter the world without the participation of the masses. There are potential exceptions, like nuclear bombs, or the lunatics in the US trying to emulate the Big Bang in a laboratory. Yet for the most part the writings of Machiavelli or Confucius or Wilfred Trotter serve perfectly well to predict how the mass will act, and to a lesser extent, how "leadership" will act.

"What are we missing?"

Not paying attention to trends. Momentum always starts *somewhere*. We drool in horror or joy as Kurzweil expounds. We read The Innovator's Dilemma and talk about radically accelerating change, when Christiansen was describing disruptions that took *decades* to happen. We are astonished by 9/11, when the forces building up to it took decades, just as we were astonished by war in Vietnam, even though diplomats had warned about Ho Chi Minh's determination for decades. Politicians are still dismissing medical warnings about microorganism mutation; though anyone of modest medical knowledge could have seen that coming in '72 by reading a catalog from the Omaha Livestock Supply Co., with 50 lb. bags of ampicillin for sale.

"What needs to be in the mix?"

More thinking. Preferably calm thinking. Most of all, more thinking about how to *correctly* influence political choices. Both politicians and technologists are at fault in this. In Ottawa there are people making vital decisions based on a summary written by a 22-year-old assistant. Despite the politician's propensity to think about lunch, sex, and getting re-elected, they have *some* grey matter to spare. But they are bombarded with predictions ranging from no-brainers to kook hypotheses. The scientific community should be more scrupulous in clearly delineating:

1. What will happen, regardless.
2. What will happen, unless we take action,
3. What will happen IF _____.
4. What might happen, period -- the way-out stuff.

If ranchers had been compelled to get prescriptions for ampicillin 30 years ago -- just as I have to for 40 lousy capsules -- microorganism mutation could have been minimised. A #2 no-brainer. Sure, beef prices might have risen. So what?

Get the predictable under control, and there is a lot more time and energy to devote to the unthinkable.

15:2) 07-FEB-2003 23:38 Phil Staal

"...who could have imagined..." reminds me of the numerous times I've been surprised to find that a "new" successful technological concept was actually well documented early in the last century. The concept only became practical though when some enabling technology was developed. I wonder if anyone reviews such old concepts in light of new enabling technologies?

15:3) 08-FEB-2003 00:16 Nicholas Carroll
Only the mad?

In truth, the fastest I've *ever* read of an idea making it to market was 7 years, for the CD. It was in production 7 years after the math that made it possible. The more common lag from idea to market is about 40 years.

I'm not sure I even find the "explosion" of the Web startling. Email "exploded" in 12 years, from 1968 to 1980. Used by quite normal people as well as pure geeks, there was every evidence of a trend. Future Shock + disintegration of family structures + mobility + personal computers + Hayes modems = d a #3, "what will happen IF _____". The enabling technology that thrust email onto the Web, HTML, was a quick hack of the pre-existing SGML; I'm not sure I would even call HTML an enabling technology. It was more a social innovation, like the Cambridge coffee pot cam.

And SMTP email protocol? Jeez, who wrote that? I think maybe Ray Tomlinson, with help from Jon Postel, back in the early 1970s.

The ecommercialization of rural America, which I've mentioned somewhere at length, is already unstoppable, even though the media hasn't noticed it. The distribution of information is coming right behind, and I don't mean Google; I mean the *sale* of coherent information on a grand scale. Right behind that follows "distance learning", what used to be called correspondence courses. These are all #1 no-brainers (settin' here on Main St., chawin' a blade of grass...)

15:4) 08-FEB-2003 08:10 Dirk Flinthart

Oh, easily. The trouble is joining the dots. The telco crash -- well, it could easily have been written up as a science fiction story: advances in telecommunications lead to media convergence, the rise of the Internet, and a huge overestimation of the market value of all that information and convenience. Thing is, it would have looked like a science fiction story, and until it came true, nobody would be interested.

Sitting by my computer is a book by John Brunner -- a science fiction writer with some truly remarkable exercises in foresight to his name (*Stand on Zanzibar*, *The Sheep Look Up*, and *Shockwave Rider* just to name a few.) This book was published around '74 or '75, and it posits a sort of "Fortress America" withdrawing from the world behind a massive nuclear shield.

Well, okay -- Brunner doesn't write about the US trying to run the world... but he extrapolates quite brilliantly within the book about American *cultural* isolationism. Even more sharply, he extrapolates the power of the Dept of Defense, and the influence of corporations on the government of America... from twenty-eight years in the past.

Reading it is, in places, quite remarkable for the eerie parallels. So right there, off the top of my head, is an example of the 'unthinkable' being thought. But it's a scattergun approach. As well as the sharp parallels, there are places where his future diverges wildly from our reality. So the problem is not 'thinking the unthinkable', but as I said: connecting the dots. Choosing which are the genuine pathways leading from the present to the future, and which will be nothing more than quantum-event parallel futures...

No. I've got no better idea than anybody else as to how to do that. I'm just good at making up such things, as much for the fun of it as anything else.

15:5) 08-FEB-2003 16:36 Burl Grey

I believe it all comes down to what is politically possible, which I fear bodes bad for everybody: with the despotic and rogue Nation States obviously worse by powers of ten. Understanding 'scale free' networks and how individuals come to occupy nodes is probably the most interesting and important area.

I remember when Richard Perle was in the US Defence Department (circa 1974) [In more spin-free days it was called the War Department] where it was observed that no amount of data or excellence of argumentation could move from his desk without passing his ideological litmus test.

I have no reason to believe this will change in the world as evolved up to this point; Perle being perhaps only it's most egregious and still visible practitioner...

This is part of why I like what I snipped from Dirk's post here:
MY emphasis added in bold

"...I would personally like to see some of this upcoming Magic Modelling Technology applied to the "science" of economics. In Australia -- and from what I can see, America too -- politicians make decisions based on their personal ideologies, but they hold up the voodoo doll of 'economics' to sell their own prejudices to the public. If we're going to accept that massive computing power will really-truly yield powerful models of complex systems, then I would argue that first and foremost, we need to turn that power towards the economic structures of the world..."

I hope everyone takes the time to read the snip, below, I took from Roy Rappaport's essay about [Adaptive Structure and Its Disorders](#), because it addresses what I think is central to the **characteristics of systems at all levels.**

I believe the language of this essay and its perspective in the ecology of ideas is close to extinction because it is both too technical for and does not serve the purposes of viable political figures!

Red is added by Burl.

"...The increasing specialization of increasingly large geographical regions is simply one aspect of increasing internal differentiation of social systems. Progressive segregation and progressive centralization were, of course, encouraged by the emergence of plant and animal cultivation ten thousand or so years ago, for plant and animal cultivation provided significant opportunities for full-time division of labor.

By 4000 B.C., if not earlier, subsistence, craft, religious, and administrative specialization was well developed. But the emergence of high-energy technology based upon fossil fuels has accelerated and exaggerated this trend and the maladaptations associated with it.

These include not only oversegregation and overcentralization, with their concomitants of ecological instability and hypercoherence; **high-energy technology is differentially distributed among the subsystems of societies and it permits or encourages the promotion of the more powerful to positions of greater dominance in systems of higher order than their degree of specialization warrants.**

High-energy technology is, of course, not alone in impelling maladaptive trends. All-purpose money has also played a part. In addition to its obvious contribution to the concentration of real wealth and regulatory prerogative, it flows through virtually all barriers, increasing the coherence of the world system enormously. Its ability to penetrate whatever barriers may have protected previously autonomous systems against outside disruption rests upon its most peculiar and interesting property: it annihilates distinctions. It tends to dissolve the differences between all things by providing a simple metric against which virtually all things can be assessed, and in terms of which decisions concerning them can be made.

But the world upon which this metric is imposed is not as simple as this metric. Living systems--plants, animals, societies, ecosystems--are very diverse and each requires a great variety of particular materials to remain healthy. Monetization, however, forces the great ranges of unique and distinct materials and processes that together sustain or even constitute life into an arbitrary and specious equivalence and decisions informed by these terms are likely to simplify, that is, to degenerate and to disrupt, the ecological systems in which they are effective.

Needless to say the application of large amounts of mindless energy under the guidance of the simplified or even simple-minded and often selfish considerations that all-purpose money makes virtually omnipotent and, when united with a capitalist ideology, even sacred, is in its nature stupid, brutal, and almost bound to be destructive.

With increases in the amounts of energy harnessed, with increases in (Page 168)the internal differentiation of social systems, with the monetization of even larger portions of life, the contradiction between the direction of cultural evolution on the one hand and the maintenance of living processes, both meaningful and material, has become increasingly profound.

We are led to ask whether civilization, the elaborate stage of culture with which are associated money and banking, high-energy technology, and social stratification and specialization, is not maladaptive. It is, after all, in civilized societies that we can observe most clearly oversegregation, overcentralization, oversanctification, hypercoherence, the domination of higher- by lower-order systems, and the destruction of ecosystems. Civilization has emerged only recently--in the past six thousand or so years--and it may yet prove to be an unsuccessful experiment.

What are taken to be evolutionary advances institutionalize new contradictions and set new problems as they solve or resolve older problems or overcome earlier limitations, and social systems may eventually become paralyzed by accumulating structural anomalies at the same time that they are increasingly perturbed by mounting substantive difficulties. It may be recalled that both Bateson and Slobodkin have argued that it is good evolutionary strategy for evolving systems to change no more than persistence requires, but increasing systemic deformity may require radical correction. Revolution has historically been an ultimate corrective response of systems so affected by maladaptation as to be unable to respond homeostatically to events continually perturbing them. Flannery has argued that the radical correction of structural anomaly has been an important factor in the evolution of civilization (1972), and inquiry into the dynamic relationship among structural anomaly, substantive problem, and profound corrective processes is, in other terms, central to the thought of Marx.

Bateson (1972), however, has located the problem at a level that may be beyond the reach of revolutionary correction-- in the characteristics of human intelligence. He argues that purposefulness is the dominant characteristic of human reason, a plausible suggestion, for purposefulness, encompassing both foresight and concentration, must have been strongly selected for during man's two or three million years on earth (and even earlier among man's prehuman forebears and other animals). But, located in the conscious minds of individuals and serving in the first instance their separate survivals, purposefulness must incline toward self-interest or even selfishness. (Indeed the philosopher Bergson in recognizing this problem took religion to be society's defense against the "dissolving power" of the human mind.) That some human purposes are selfish cannot be gainsaid. But Bateson suggests that the problem of purposefulness is more profound. Purposefulness, he argues, has a linear structure. A man at point A with goal D (Page 169) takes actions B and C, and with the achievement of D considers the process to be completed.

Thus, the structure of purposeful action is linear: A - B - C -, D. But the world is not constructed in linear fashion. We have already discussed the circular structure of cybernetic, that is, self-correcting, systems, and it is well known that ecosystems are roughly circular in plan, with materials being cycled and recycled through the soil, the air, and organisms of many species. Moreover, the circularity of both cybernetic and ecosystemic structure blurs the distinction between cause and effect, or rather suggests to us that simple linear notions of causality, which lead us to think of actors, objects upon which they act, and the transformation of such objects, are inadequate, for purposeful behavior seldom affects only a single object, here designated D, but usually many other objects as well, often in complex and ramifying ways. Among those being affected in unforeseen and possibly unpleasant ways may be the actor himself.

It may be suggested, however, that linear, purposeful thought is adequate to the needs of simple hunters and gatherers, and not very destructive to the ecological systems in which they live, because both the scope and power of their activities are limited. It is when linear thought comes to guide the operations of an increasingly powerful technology over domains of ever increasing scope that disruption may become inevitable.

Bateson argues that the problem is not only to make men aware of the ramifying and circular structure of the universe, but to make the imperatives of this structure more compelling than their own linearly defined goals. He believes that this requires that more of their minds than their conscious reason be engaged. It is also necessary to engage the nondiscursive aspects of their processes of comprehension, and he suggests that this is achieved through art and religion. I would agree, and elsewhere in this volume [Sanctity and Lies in Evolution I](#) discuss the place of religious experience in adaptive structure.

To argue that more than reason may be required to maintain adaptive structure in human social systems, or to restore adaptiveness to systems beset by maladaptations, is not to argue for the banishment of reason nor for its replacement by blind commitment or mystic insight. Conscious reason has entered into the evolutionary process, cannot be ignored, and should, obviously, be put to the task of rectifying adaptive difficulties. An apparent paradox may be that attempts to solve problems of adaptation are likely to cause further problems, perhaps because "problem solving" is in its nature linear.

Moreover, the systems in which men participate are so complex that we cannot now, and probably never shall be able to, analyze them in sufficient detail to predict with precision the outcome of many of our own actions within them. We must, therefore, (Page 170) investigate the possibilities for developing theories of action that, although based upon incomplete knowledge, will permit us to participate in systems without destroying them and ourselves along with them. This task is not hopeless. To say that the complexity of living systems is so great as to confound prediction is not to say that we cannot apprehend the salient characteristics of their structures.

15:6) 09-FEB-2003 07:14 Dirk Flinthart

Oh! I do like this Rappaport chap. I've been arguing for years that money is essentially an abstract idea, but is continually used as a concrete thing, and has become in its oversimplified form, the measure of all merit. And conversely, anything which cannot be measured in terms of money is seen as being without merit. Monumentally stupid and destructive thinking... how did we ever let ourselves become hostage to it?

Well, money is just such a nice, simple means of *keeping score*.

15:7) 10-FEB-2003 16:30 Burl Grey

I'm claiming the vital civilized function of money has much deeper and darker implications beyond mere *keeping score*. Its invisible influence reinforces rationality, objectification, fragmentation and linear purpose. Way back in [1900](#) Georg Simmel said:
(MY emphasis):

"Money in the modern world is more than a standard of value and a means of exchange. Over and above its economic functions, it **symbolizes and embodies the modern spirit of rationality, of calculability, of impersonality.**"

"Under its aegis, the modern spirit of calculation and abstraction has prevailed over an older world view that accorded primacy to feelings and imagination."

In view of this I was struck, in **my** reading of Howard Rheingold's "Smart Mobs", by *how* his chapter - The Era of Sentient Things - is followed by - The Evolution of Reputation -: page 114
"*Reputation marks the spot where technology and cooperation converge.*"

The final section in the book recapitulates as "Cooperation Amplification" acknowledging what I take to be **the** dilemma both now and worse again in the future: We must find ways of trusting and being comfortable with strangers in very large, complex environments! We evolved in small tribes and I suspect our ability to deal with large numbers of strangers, comfortably, is *very limited!*

These days we are told to be especially attentive to strangers and 'unusual conditions' because we are in a very long term War on Terror!

How do we model/predict this?

While modeling and predicting (essential activities) will certainly get better in many ways; with the with explosive growth of *social complexity* the very idea of 'initial conditions' and 'regularities' so essential to modeling seems, to me, to defy analysis.

Which is my reason for focussing on social [the hard part: 'what it means to be human'] rather than the technological [easy part] of forecasting.

Most people I see every day are strangers to me and in increasing numbers are walking along talking intensely to someone in their hand [cell].

15:8 10-FEB-2003 16:36 Bob Watson

I recall reading somewhere that military organization has it right -- the largest group in which people can really know each other (warts, proclivities, and all) is about 120-150, the size of a "company." So an issue might be -- how does one create "company sized" organizations for work and play?

15:9 10-FEB-2003 17:09 Nicholas Carroll

Ask 3M Corp.? I've long suspected they deliberately keep their divisions very small to foster better cooperation between employees.

Or who knows? Crazy, maybe, but perhaps they're being ethical, heeding Jung's observation "... the elementary axiom of group psychology, that Man is morally and spiritually inferior in the mass."
[Quote cribbed from memory, may be slightly off.]

15:10 11-FEB-2003 01:04 Charles Cameron

I wish I'd been able to participate a little more all the way through this conference, but I'm finding myself forced to drop a rather large "chunk" in right at the end -- please excuse my longwindedness!

Here goes:

Observation:

Nicholas at [Item 5:55](#) said something remarkable:

It's inevitable -- and the dictators aren't going like the consequences. As someone smarter than me once observed, "Energy revolutions always breed social revolutions."

What's so striking here (for me, I'm sure others get different insights, but this is the one that catches my attention) is that we can see here in a nutshell how *causality reaches across our specializations*. Specifically, it moves back and forth across the Cartesian divide between the objective and subjective realms.

This was part of what was so fascinating to me about watching the social implications of the Y2K threat – the way in which a (potential) technical failure threatened to cascade into such areas as psychology and religion on its way to economics and national security.

□ **15:11) 11-FEB-2003 01:07 Charles Cameron**

Examples:

If I may, I'll discuss this in terms of one of my own specialties: the study of the peculiarly intense religious groupings known as "apocalyptic" or "millennial" movements. And if you feel inclined to skip this part, please don't -- my point exactly is that this is potentially "uncomfortable" material, which it's only too easy to overlook!

Such movements hope for a major transformation in human affairs in the near future: they have an intense dislike of and sense of alienation from the powers that be and the way they perceive the world to be run – which they see as corrupt and unjust – coupled with an extraordinary hope of a just and righteous new world – in which they themselves will play an important role, a true believers. Because they view the change from corruption to incorruption (biblical echoes here no mistake) as imminent, they follow current affairs with keen attention -- filtering the newscasts and movies they see, the newspapers and science fiction novels they read through a filter of "signs of the end times" (Islamic, Christian, Judaic, Hindu, Native American, New Age). And this can add a high moral significance to everything from innocuous commercial items like bar codes and ID implants (both of which have been considered "signs of the beast") to public figures (viewing Reagan, Clinton or Prince Charles as Antichrist).

I remember during the runup to Y2K the FBI was concerned enough to issue a document about apocalyptic thinking ("Project Megiddo") to a national convention of chiefs of police, and the American Banking Association put out a sermon for use in churches, temples and synagogues. Law enforcement knew that a religious groundswell around the year 2000 rollover might include increased militia activity, and the bankers were worried that rumors of bank failure would translate into runs on the banks... and thus turn out to be self-fulfilling predictions.

The FBI paid attention to apocalyptic rumblings because Waco and Aum Shinrikyo had taught them the dangers inherent in insufficient awareness of apocalyptic religious movements, the Chinese are still learning the same hard lesson vis-à-vis Falun Gong (which they should have learned from the Taiping Rebellion).

Think of an article about the Ebola virus in New Scientist or the New Yorker. The writer expects it to be read by sane, balanced citizens with an "enlightenment" lack of superstition and a generally mature attitude to the world which includes a wish for the rapid containment of powerful disease vectors. What the writer is unlikely to envision is the reader in an obscure new Japanese variant on Buddhism, who reads it as an opportunity to get hold of a new and vicious weapon for a cosmic war against the Japanese government and then the world!

Aum Shinrikyo, the folks who gave us sarin in the Tokyo subway, sent a 40-person crew to Zaire to pick up samples of Ebola for their Tokyo labs.

*

I'm including a bunch of examples here because I believe that religious belief is something the technically sophisticated among us often relegate to a sort of quiet backwater -- comfortable and safe -- whereas in fact it's a blindspot, a sort of left field out of which some of the most appallingly dangerous unexpected consequences can come.

In Canadian terms, Raelians and Sikhs are two groups who tend to put a distinctive interpretation on world affairs, and can thus function as powerful wildcards.

Think in particular how a given genetic or AI technology will be perceived by the Raelians, how *they* will position themselves, what *their* impact will be on the resulting debate... How has Clonaid's intervention affected popular perception of cloning? Legalisation issues? Funding prospects? And so on...

□ **15:12) 11-FEB-2003 01:12 Charles Cameron**

And by way of conclusions and recommendations:

We talk about the interconnectedness of the modern world, and we may think of routers and protocols: but the routers and protocols that can shift emotions through a population – which is to put it bluntly what it takes to start or defuse a riot, a jihad, a revolution – these are far less well understood, far more subtle, far less easily mapped. And in some final analysis, far more crucial.

Rule:

Unintended consequences are in one way more consequential than intended ones -- because we haven't planned on them and are therefore caught unprepared by them. Know your blind spots and studiously illuminate them. Make a specialty of tracking the "left field".

Recommendations:

All scenario planning and future studies teams need representatives of "interior" disciplines such as depth psychology, social anthropology and comparative religion to cover the "wildcard" influences that result when non-standard worldviews evaluate social events in their own strange ways.

All scenario planning and future studies need to take into account what I'd call the "undertow" of the tech and social "marvels" they are studying – the mechanisms of resentment, disaffiliation, alienation and backlash.

Find ways to map culture, belief, worldview, folklore, and superstition as drivers -- alongside the more readily quantifiable early indicators and trends...

15:13) 11-FEB-2003 01:32 Nicholas Carroll
"... causality reaches across our specializations."

Amen. Thanks, Charles.

EDIT: Ditto amen to your last post, which slipped me. As Abbe Seives replied when asked "what he did during the revolution" -- "I survived." I expect he had an eye on left field.

15:14) 11-FEB-2003 12:22 Charles Cameron
[I've been appreciating your posts too, Nicholas. Thanks.]

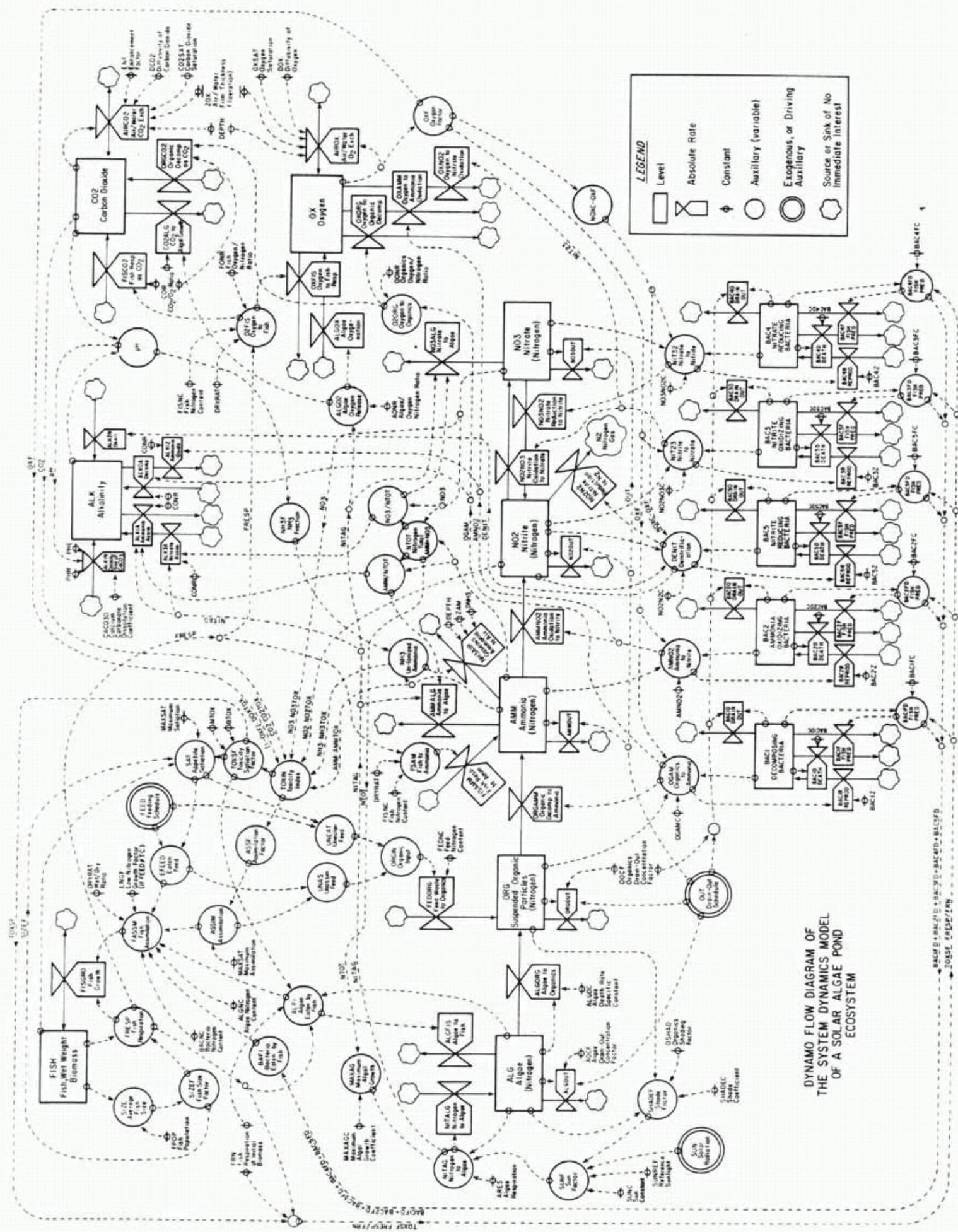
15:15) 11-FEB-2003 14:53 Robert Crosby
re Foresight: What's my take?

I have experimented with growing herbivorous fish (tilapia aurea) in a 'solar-algae' tank, with lettuce & watercress growing on styrofoam floats on the top. The lettuce roots dangle into the nutrient rich water, and provide surface area for symbiotic nitrifying bacteria which remove the nitrogenous fish wastes (and feed the plants). Algae grows in the nutrient-rich water. The fish eat the algae, the algae make the water green, which makes it a much better solar energy absorber. The whole system produces fresh produce, meat and thermal mass for solar heat storage with unexcelled efficiency (orders of magnitude greater than any 'green revolution' agri-business processes).

Here is a systems dynamics model of energy and nutrient flows through the system, developed by a guy named Ron Zweig, biologist extraordinaire, and teacher of an integrated aquaculture course I attended in 1988. At the end of the course, after we were all suitably impressed with the knowledge that we had gained, he left us with a personal anecdote to put it all into perspective.

As a consultant to the UN he took his model (and deep understanding) to China, where he was working with local scientists to help develop pond-dike systems in the Yangtze River basin. After presenting his analysis, and detailed explanations of how it would all work--the many complex interactions between the different plants and animals--a local farmer raised his hand and asked "Well, what about the snakes?".

He had no idea what the guy was talking about. It turned out that the entire model collapsed if the farmers were afraid to cut the grass on the dikes to feed the grass carp, a keystone species of the whole system. It left him humbled.



Nrc Foresight Workshop Item 15

[Home](#)

Items: [1](#) [2](#) [3](#) [4](#) [5](#) [6](#) [7](#) [8](#) [9](#) [10](#) [11](#) [12](#) [13](#) [14](#) [15](#) [16](#)

Nrc Foresight Workshop

Item 16

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

Wildcard: Mainland China

Item 16 10-FEB-2003 16:59 Nicholas Carroll

A scenario from the Geostrategics report:

China becomes dominant world economic power, surpassing US, Japan and Europe; progressive change to new world order.

In process of writing a report on emerging wireless technologies, I asked a sinologist colleague in BC for a review of my take on Asia, and thought his answer, while necessarily somewhat tangential, might be of interest. Norman Goundry agreed with my basic take on China, and went on a bit more broadly. I attach his comments below. I don't always agree with Norm's global take, but have found him extremely accurate in predicting the actions of Oriental nations. *[Norm is something of a polymath -- an eminent translator of Chinese medical works and the Taoist canons, a programmer, and one of the world's leading authorities on the encoding of Oriental characters. Also a bit controversial after his online article "Why Unicode Won't Work on the Internet." I never did get so many vitriolic flames from Ph.Ds. But hey, what's a little high-sticking between friends? Anyway the emails from the Orient said "Thank you."]*

"Given that it appears China has already drawn up even with or even passed Japan in several significant areas of importance, and is increasing pressure on both those leads and all other areas of growth, then one must view the technology wars question as it stands as being one-third answered. I would offer an alteration on your theme, wherein Japan is withdrawn as a main global contender, and is replaced instead with India.

"Seen as a footrace, China (and India) have already drawn up with and are passing a flagging Japan, and now within striking distance of the usual top contenders, the US and the EU. Under the circumstances, a seasoned bet-placer would consider not so much who is in the lead of a front-packed field at the moment, but rather who possesses the greatest amount of reserve potential and desire to win the race.

"According to general statistics available a year ago, it seemed that India had the capability to exceed China, but the increase of tensions between India and Pakistan almost leading to war has been a detaining factor on India's growth and global expansion. Likewise, the overdemand of

military conflict between the US and Iraq, North Korea, Afghanistan and fundamentalist terrorist organizations around the world, have succeeded in drawing the US's attention away from the problems of its current economy. The US is in the position of throwing an enormous amount of its capital and human and energy resources into a struggle to achieve short-term insular security for its nation. It is gambling its long-term global super-status on stabilizing both its own need for energy resources and a gambit of parallel neutralization of the fortunes of the OPEC states.

"In contrast, the EU is now openly challenging the dominance of the US concerning global matters (most recently over UN inspectors and a seeming zeal for war). But the strategies of both the EU and China are based upon reticence to engage in power-sapping conflicts which no one really knows the long-lasting results that will be produced. China is expanding its strengths internally via growth of infrastructure and economy, while maintaining its death grip on the production and export of IT and electronics-based goods. The EU is expanding itself externally through the willing absorption of smaller countries to its east. This invigorates the EU's manufacturing market into what is now the largest trade bloc on the globe.

"So it seems that regarding continued growth and expansion, China is the brightest star in the East and the EU is the brightest star in the West. It will be up to the deployment of long-ranging foreign policy skills by either of these two giants to determine who dominates overall in the end. A good gambler would split their bet between the two."

16:1) 10-FEB-2003 17:14 Bob Watson

Quite a wildcard -- one question might be whether or not China can retain internal control. Historically, "China" beats between amalgamation and dissolution. I'm not at all sure where China is in the current process -- the outside pressures of the 20th century helped it stay in one piece (anticolonialism, Maoist theomaxism, to coin a term).

Will success spoil its good looks? Dial in tomorrow.

16:2) 10-FEB-2003 17:24 Nicholas Carroll

Hehe. Yep, it's a fair chunk of country to control as a "nation." "Last-bad emperor" and all that. However, I think at present China still feels those outside pressures. Be assured that they have not forgotten or forgiven the Opium Wars.

Related excerpt from a piece I'm writing for Donald Melanson's ezine www.mindjack.com, "Realities of Online Reputation Management" (good for 487 flames....):

"The Failure of Censorship

"Outside of the two major captive pseudo-Web audiences -- AOL subscribers and Yahoo!-for-everything devotees -- the Web to date has shown no mechanism by which one can censor news on a grand scale. As the saying goes, "The Internet routes around damage." (Reasonable enough. That's what packet protocol was designed to do.)

"Governments can censor the Internet en masse, of course -- but as the wealth of information online increases, so too will the technological advancement of a nation. At very different technological poles, the American and Mainland China governments have two versions of the same problem: American dogma insists that America must maintain technological superiority, much as British policy once insisted that "Britannia rules the waves." The Mainland Chinese leadership is driven by an equally unshakable dogma, that China never again be "the sick man of Asia."

"This puts either government in a difficult position. American business interests need an open Internet to continue dominating the playing field. Mainland China needs an open Internet for the informational input to assure that they will never be a slave to American dominance.

"Therefore the dominant nations, or those who wish to be dominant nations, cannot at present afford to entirely block off Internet access. (The governments will certainly spy on their citizens, but that is another matter.)"

16:3) 10-FEB-2003 17:27 Jim W. Lai

[Edited due to context slippage.] The Old Guard who found in the Revolutionary War aren't entirely dead yet. That could easily happen within the posited time frame. A new generation without direct experience of the hardship of protracted war will think differently. New technologies will probably enhance the power of the state to effectively monitor its citizens.

16:4) 10-FEB-2003 17:39 Nicholas Carroll

"A new generation without direct experience of the hardship of protracted war will think differently."

True -- to an extent. But forgive and forget? I recently observed to a New Zealander, regarding the sinking of the Rainbow Warrior in Auckland harbour: "Oh well. Allowing for the high percentage of Scots blood in New Zealanders, the whole thing should blow over in 150 years or so."

16:5) 10-FEB-2003 17:51 Jim W. Lai

It's possible the USA sees beyond mere insular security (Fortress America) and recognize this moment as uncontested unipolarity in the world (as opposed to multipolarity) and are taking advantage of the opportunity to maximize their influence in the coming years. (I base this view on some superficial skimming of some neoconservative web sites.) They may not get another chance like this for a long time to come. Carpe diem. The more they are able to influence, the more buffer they have against decline later on. If they achieve firm influence in an area first, competing powers such as the EU and China will have to struggle harder to wrest it. This presumes near-optimal execution, of course. If so, expect aggressive expansion of American influence.

An American lock on oil reserves may limit EU and Chinese economic expansion long-term.

A bizarre but not wholly impossible scenario would be for rights to degrade and corruption to increase within the USA to the point where there is little to distinguish it from a liberalized China that implements rule of law.

16:6) 10-FEB-2003 21:07 Nicholas Carroll

The "opportunity" is compromised by competing American agendas as well as the American Way of "Ready! Fire! Aim!" This is failing to impress Asian countries as well as the EU. They are interested in selling into the US market, but not at all interested in having US monopolies like MS or Unicode infest their countries.

"A bizarre but not wholly impossible scenario would be for rights to degrade and corruption to increase within the USA to the point where there is little to distinguish it from a liberalized China that implements rule of law."

Yup. So make sure Customs Canada has plenty of coffee on hand. The 49th could get busy.

16:7) 11-FEB-2003 05:32 David Brake

Whatever the theoretical potential of India they are a long way behind China and seem to be continuing to stumble. As for the "impossibility" of effectively censoring the Internet, take a look at some of the stuff here:

http://www.ceip.org/files/projects/irwp/irwp_home.asp

16:8) 11-FEB-2003 12:57 Nicholas Carroll

Mmm? From my post "Governments can censor the Internet en masse, of course ..." And of course an individual government can selectively censor as with China blocking Google and AltaVista.

India is behind China, IMO. However some of that is Western perception. Due to India's huge home-grown media/entertainment complex, their news does not reach the West readily. Among other unnoticed trends, in recent years they have started to produce a better breed of programmers, on a par with Russian programmers.

16:9) 11-FEB-2003 13:13 Jim W. Lai

Management skills will be a limiter as economies expand.

16:10) 11-FEB-2003 14:36 Nicholas Carroll

:-) In the U.S. management skills were a grand limiter by the 1960s, as companies began appointing financial (or whatever) specialists as CEOs. In the 1930s, by severe contrast, CEOs typically had degrees in, yes: English! As someone pointed out (perhaps Drucker), this was near-ideal, because a command of English was the perfect tool for broad understanding of both specialties and the environment, and gave a CEO the ability to communicate with diverse types of employees.

Alas, Babylon.

16:11) 11-FEB-2003 14:48 Bob Watson

A long way from China here ... :-)

Re management, pity is that beancounters, by and large, have neither understanding of specialities nor employees. They, ah, don't count.

Nrc Foresight Workshop Item 16

[Home](#)

Items: [1](#)[2](#)[3](#)[4](#)[5](#)[6](#)[7](#)[8](#)[9](#)[10](#)[11](#)[12](#)[13](#)[14](#)[15](#)[16](#)

