Future of Regulations

2030 a changed world: implications for public interest and regulation

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Abstract

This brief highlights fifteen areas of significant change – technological, economic, political, social and environmental – which will reshape our world over the next 20 years, and discusses some of the potential implications within health care.

Individually each of these changes presents major challenges to governments; collectively, they will increase the complexity of the context within which governments will operate and demand new, faster and more flexible approaches to public debate and regulation.

These changes will create major opportunities as well as threats; challenge perceptions and definitions of public interest including health and health care; change the focus and balance between personal and public decisions and responsibilities; blur the boundaries between the government, corporate or voluntary sectors; require a radically new form of public debate; create tensions over time and between generations; provide opportunities for radical innovations but also inherent risks to individuals and the wider public interest.

Governments will need to take a more holistic interdisciplinary approach to developing regulation. Resilience and effective regulation will be as much about explicit roles and responsibilities at different levels and among different actors in the system as it is about specific regulation. Collaboration and not command and control will be essential to engaging wider support for radical change and innovation. Proactive discussion and debate of the potential of new technologies, the need for radical changes to reduce costs, improve quality and ensure the benefits to individuals, communities and nations will be needed to allay fears and promote the potential of the future.

On a global stage, Canada could build on its international peacekeeping role to take on a new role as a neutral leader of debate about the impacts and implications of these changes and how to balance individual, community, national and international/ global priorities.

Selected characteristics

- Simplification of regulation will be expected, so that all stakeholders can act effectively within the system. Without this approach, an avalanche of regulation to try to control complex situations is likely to result. So too is an ocean of litigation.

- Simpler 'rules' such as 'do no harm' combined with always on, smart technology to provide verification and spot checks of compliance and status may become the norm.
- Transparency and trust among and between all stakeholders will be essential to achieve the frameworks needed to foster radical innovation.
- The kinds of choices and trade-offs which may be necessary, as well as the ethical debates likely to arise from new technologies will demand open collaboration and innovation in order to engage stakeholders in the changes necessary.
- An interdisciplinary cross government approach which takes a long term view of change will be essential – to avoid surprises and costly mistakes and reduce unforeseen consequences.
- The range and speed of technological change will mean that regulators are constantly playing catch up.
- New models of care and an increasingly global market with a range of different styles of and approaches to provision and variable cost models will make regulation more difficult while also requiring internationally coordinated approaches.
- As health care becomes both more personal and more preventative, regulation will be even more difficult. Transparency will be essential to avoid massive complexity and litigation.
- System security to protect data but also ensure power supply and communications (e.g. for remote monitoring) will create a complex system of responsibilities.
- A more global market place will require international collaboration on regulation, standards locus of responsibility and transparency.

History

The dictionary definition of public interest is deceptively simple: *The people's general welfare and well being; something in which the populace as a whole has a stake*[1]. However, public interest has many layers and many manifestations. Regulation has a similarly simple definition: *A rule designed to control the conduct of those to whom it applies.*

Canadian values

National psyche and values play a significant role in defining what is regarded as public interest. Canadian culture has traditionally tended towards more collective than strongly individualistic values as a society. A recent marketing study, which examined some of the dominant themes in Canadian culture, highlighted examples of four main traits[2].

- Individual autonomy versus collective responsibility. The survey portrays this as both respect for difference, Canada was the fourth country to legalise gay marriage, but also a desire and support for public education and health systems.

- Acceptance and tolerance. It describes Canada as not only multi-cultural, but multi-everything, highlighting the fact that multiculturalism scores second, after democracy, as a source of national pride in surveys. Part of this diversity, it suggests, is the fact that Canada has never been a unitary entity always a federation, has several languages and is also a secular nation.

- A unique quality of life. Quality of life Canadian style focuses on relationship and experiences not things, a less frantic way of life closer to nature. For one fifth of Canadians quality of life is the top source of pride in being Canadian.

- A peace loving nation. A sense of security translates not only into a desire for peace but also a willingness to help others maintain peace worldwide, honesty in business and a low murder rate.

Political context

Changing definitions of and past attitudes to the idea of public interest are also visible in the wider political arena and election successes of different political parties. The Liberal centre left party dominated Canadian politics from the Second World War till 2006, with the exception of a ten year period from the mid 1980s to mid 1990s. Since the 2006 election, the Conservative party has been in power and returned with an increased majority in the 2008 election.

The early 1980s were characterised by an emphasis on a just society. This included legislation on bilingualism for Quebec; a focus on multiculturalism and a charter of rights.

Then, in line with many other western countries, there followed nearly a decade of conservative government. Reagonomics and Thatcherism became global bywords of the 1980s, Canada was not immune and here too there was an emphasis on tax cutting and the introduction of a consumption tax. The change reflected a shift in emphasis away from big government and state support, epitomised by Margaret

Thatcher, who famously once said: 'There's no such thing as society' and went on to say:

> *"I think we've been through a period where too many people have been given to understand that if they have a problem, it's the government's job to cope with it. 'I have a problem, I'll get a grant.' 'I'm homeless, the government must house me.' They're casting their problem on society. And, you know, there is no such thing as society. There are individual men and women, and there are families. And no government can do anything except through people, and people must look to themselves first. It's our duty to look after ourselves and then, also to look after our neighbour. People have got the entitlements too much in mind, without the obligations. There's no such thing as entitlement, unless someone has first met an obligation."*
> **Prime minister Margaret Thatcher, talking to Women's Own magazine, October 31 1987**

The 1990s saw the return of the Liberals, who astonished the populace with a new openness, by publishing the 'Red book' of intended actions in government. Of necessity, there was an emphasis on budget cutting and prudence in the wake of the recession, but also a vocal stand against the invasion of Iraq and the promotion of same sex marriage.

2006 saw another shift to the Conservatives in the wake of a scandal involving the Liberals. Since then a second election has given them an increased majority on the back of tax cuts and a universal child allowance. There are indications that if a new election were called, the Conservatives might win an outright majority.

During the 4 years to 2009, debt as a percentage of GDP rose from 26% to 46%. Canada then followed many other countries in returning a conservative government.

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From nationalisation to economic nationalism

Nationalisation has also been an element of public interest in the past. In the post war era, until the mid 1970s various industries – such as hydro-electricity and oil interests - were nationalised. Nationalisation has been replaced by what could be termed economic nationalism in many countries, such as France, Spain, Italy, Australia and the USA, where takeovers of strategically significant companies have been resisted on the grounds of national interest. The recent refusal by the Canadian government to allow BHP Billiton's takeover of Potash Corporation, is one such example, and the Prime Minister announced that it did not '*present a likely net benefit to Canada*.'[3]

The prevailing mood, cultural values and political tendencies all colour public interest and regulation.

Current conditions and changes

Aspects of public interest

Despite the simple definition, public interest is not a single immutable concept. Numerous facets play a role in public interest as well as a number of core areas of activity within which public interest in turn plays a role.

Many of these facets can be linked with different sets of needs and priorities – for example timeframe: actions which appear to be in the public interest today may be to the detriment of people in the future and vice versa; scale can span from the individual up to the global – developments and needs at each of these levels can cumulatively affect and be affected by the concept of public interest. Events and changes in many different areas - national values and politics, world events and prevailing philosophies, generational differences and aspirations, new technologies changing how we do things – to name but a few, will interact with and alter the balance and implications of some or all of these different facets, thus changing the nature of public interest and the need for different responses and regulation. Some of these potential facets are set out in Table 1.

Table 1: Potential facets of public interest – a spectrum of contrasts

	ASPECT	
Personal , Local	SCALE	National , Global
Urban	CONTEXT	Rural
Short term	TIME FRAME	Long term
Minority	REPRESENTATION	Majority
Liberal	VALUES	Authoritarian
Divergence	PUBLIC OPINION	Consensus
Individual choice	AUTONOMY	Public consequences
Self regulation/ voluntary	ACCOUNTABILITY	Legal/ enforced
Personal privacy	REPUTATION	Public right to know
Exposure	TRANSPARENCY	Confidentiality

Source: Shaping Tomorrow

Areas of activity within which public interest can play a role are wide ranging and encompass: national security; economic potential and competitiveness; education and skills; natural resources and eco-systems; individual wellbeing and health; food and agriculture; population levels and distribution; infrastructures; institutional governance and social capital.

In discussing the changes surrounding and potentially affecting public interest and thereby regulation this brief will touch on some of these facets and components.

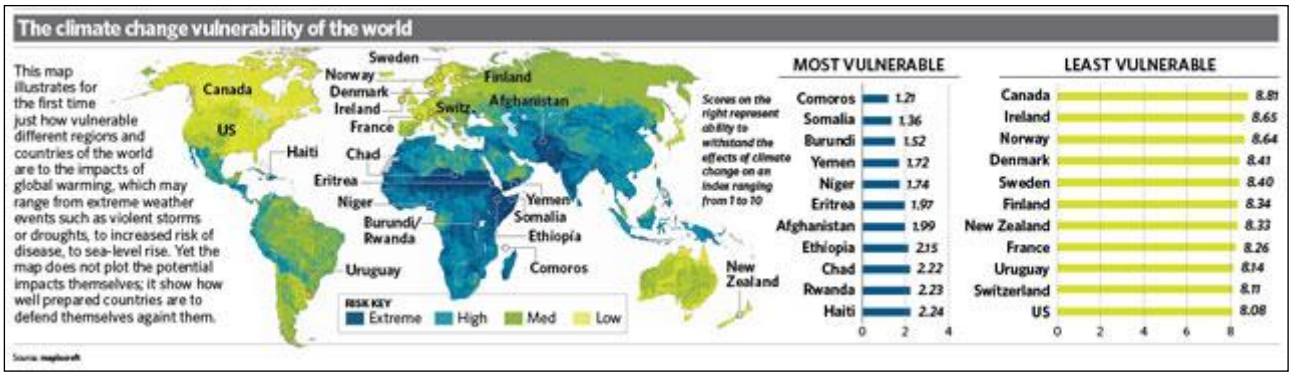
Long term changes

Over the next 20 years, trends already visible today will come together and radically affect how we do almost everything. We have set out very briefly below some of the most significant trends and drivers of change, many of which are familiar and each of which reflects major change in its own right. The aim is to highlight the changes, not discuss them in detail – the many detailed studies available elsewhere do that. In the following section we then discuss some of the ways in which we might do things differently, the potential implications for public interest and therefore regulation.

Climate change and extreme nature – the norm

Climate change and its causes are the focus of numerous major scientific reports, projects and ongoing debate. A recent report highlighted not the nature of climate change or its causes, but the risks posed by global warming to 168 countries worldwide. 8 of the 10 most vulnerable are in Africa: Canada is scored top, i.e. it is least vulnerable, better placed to adapt and cope. The index combined scores on 6 areas of potential impact or vulnerability: the economy; natural resources and ecosystems; poverty, development and health; agriculture; population, settlement and infrastructure; and institutions, governance and social capital. These risk areas also correlate strongly with components of public interest.

Figure 1: Global warming country risk index



This is not to say that Canada is immune to climate change: it is not. Changes to the Arctic icecap could open up vast tracts of new agricultural land while also changing the way of life in the region; those same changes will open up the Northwest passage to more frequent shipping creating new economic opportunities, while also raising issues of environmental protection; changing temperatures could bring new diseases and health issues, as well as changes to ecosystems, crops and agriculture, and potentially undermining the way of life of the Inuit. The global economic costs of climate change are estimated at $150 billion per year, Canada will have a share in that loss[4]; the cost of lost ecosystem services from, for example wetlands and bees, is put by TEEB at between $2 and $5 trillion per year[5].

Extreme nature has demonstrated its power with horrific consequences in recent years with growing numbers of disasters on an unprecedented scale, the most recent being the earthquake and tsunami in Japan. Lesser but nonetheless significant events such as ice storms, localised floods and wild fires are all part of seemingly increasingly unstable weather systems. Climate change is thought to increase the likelihood of such events.

Adaptation rather than mitigation is increasingly the focus of debate. But so too is resilience, the ability to adapt, to respond to crises if and when they occur and to create systems, communities and individuals capable of weathering the storms – literal and metaphoric – ahead.

Climate change and disasters affect health, and often adversely and disproportionately the elderly, infirm and less well off. Climate change may bring new diseases, not only directly to Canada but to areas where tourists can pick them up. Increased travel will make diseases spread faster – such as the flu Pandemic, but restricting travel may also be part of controlling them. Even more basic problems like the bed-bug outbreak in New York can be spread as a result of business and tourist travel.

QUESTION: WHAT ARE THE IMPLICATIONS FOR PUBLIC INTEREST AND REGULATION?

- How prepared are health systems for crises?
- How resilient are populations at the individual and community level? To what extent can and should policy makers intervene before unlikely, rare but high impact events occur? At what stage should individual freedom to travel be restricted because of the wider need to mitigate and adapt to climate change? Should discussions of options like personal carbon budgets be as much a

health as an environmental issue? Where is the balance of public interest and therefore how tight should regulation be?

- What implications would opening up areas of land to settlement and agriculture in the north have on service provision?
- Would new territories attract new immigrants?
- To what extent can Canada transfer its peacekeeping role to health promotion relative to climate change – a different kind of peacekeeping?

New power structures and a multi-polar world

The economic shift from West to East, North to South is well underway. China is already the world's second largest economy, although its per capita income still lags far behind the other leaders. According to a PWC report[6], by 2050, and possibly sooner, China will be the world's largest economy; India the third largest – albeit far behind China and USA. Morgan Stanley estimates that India will be producing the largest number of graduates of any country globally and that Indian growth out to 2020 will exceed that of China[7] - President Obama certainly takes this threat seriously and is calling for greater investment in developing graduates[8]. In addition, Indian companies such as Bharti Airtel and Chinese companies such as Huawei are investing heavily and successfully in Africa to provide key mobile infrastructures and services. A new economic and political order is emerging; by 2030 the 'west' will be one among many.

3. The top 30 in 2050

	Order in 2050 by size	Size of economy in 2050 (Bn, Constant 2000 USD)	Rank change between now and 2050	Income per capita (Constant 2000 USD) 2050	2010	Population (Mn)
1	China	24617	2	17372	2396	1417
2	US	22270	-1	55134	36354	404
3	India	8165	5	5060	790	1614
4	Japan	6429	-2	63244	39435	102
5	Germany	3714	-1	52683	25083	71
6	UK	3576	-1	49412	27646	72
7	Brazil	2960	2	13547	4711	219
8	Mexico	2810	5	21793	6217	129
9	France	2750	-3	40643	23881	68
10	Canada	2287	0	51485	26335	44
11	Italy	2194	-4	38445	18703	57
12	Turkey	2149	6	22063	5088	97
13	S. Korea	2056	-2	46657	16463	44
14	Spain	1954	-2	38111	15699	51
15	Russia	1878	2	16174	2934	116
16	Indonesia	1502	5	5215	1178	288
17	Australia	1480	-3	51523	26244	29
18	Argentina	1477	-2	29001	10517	51
19	Egypt	1165	16	8996	3002	130
20	Malaysia	1160	17	29247	5224	40
21	Saudi Arabia	1128	2	25845	9833	44
22	Thailand	856	7	11674	2744	73
23	Netherlands	798	-8	45839	26376	17
24	Poland	786	0	24547	6563	32
25	Iran	732	9	7547	2138	97
26	Colombia	725	13	11530	3052	63
27	Switzerland	711	-7	83559	38739	9
28	Hong Kong	657	-3	76153	35203	9
29	Venezuela	558	7	13268	5438	42
30	South Africa	529	-2	9308	3710	57

Source: HSBC Calculations

Table 2: 2050 The world's largest economies

And if that were not enough, China and India the new powerhouses of the world economy are not alone. Although the sheer scale of development of two nations both with over 1 billion citizens mesmerises, many other nations are growing rapidly. 6 out of 10 fastest growing economies in last 10 years were in Sub Saharan Africa: Angola, Nigeria, Ethiopia, Chad, Mozambique and Rwanda – the new 'frontier economies'. The CIVETS countries - Colombia, Indonesia, Vietnam, Egypt, Turkey and South Africa are second tier emerging markets and have diverse economies, fast-growing populations, fairly stable politics, low labour costs and significant potential for growth and development – about 4.5% p.a. for the foreseeable future[9].

Not only are these countries growing individually, they are also forming new alliances and economic agreements – without the west. China and Russia for example are negotiating to dispense with the US dollar in trade; South:South trade is growing rapidly and trade groups emerging in Latin America, Africa and Asia; we have already witnessed the expansion of the G7 to the G20, during the recession- that taste of influence has whetted the appetite for more. International bodies such as the UN will need reform, but so too will the processes for global negotiations of trade or security issues.

Global opportunity will surge, but so too will competition and not from 'the usual suspects'. Power, competiveness and innovation will no longer be the domain of the west; navigating this multi-polar world will be challenging.

QUESTION: What are the implications for public interest and regulation?

- How well equipped is Canada to negotiate and forge alliances in this new, increasingly complex multi-polar world? To what extent can and should Canada rely on or separate itself from America in doing so?
- How well placed is Canada to take advantage of the enormous opportunities of the emerging markets? How could Canada take advantage of its own health care excellence to forge links and create opportunities?
- Will the need to remain economically competitive be the main driver of public interest and regulation?

Low cost business models from east to west

Then there are the new approaches these emerging market companies and their governments are developing. A combination of innovation, frugal manufacture, local market constraints such as millions of consumers with minimal income to spend is set to change the way not only emerging economies do things but also western companies and governments.

Emerging economy companies are rewriting the rules in almost every sector by stripping out costs in processes and products, from cars – the Tata Nano which stripped out everything that was non-essential to make it as cheap as possible, to iPads where the Indian government is aiming for a $100 version within a year, to fridges - Godrej & Boyce Manufacturing has developed a $70 fridge that runs on batteries. Similarly frugal innovations are emerging from China where networks of suppliers are used to create flexibility of supply but also innovative solutions to problems.

Health care is also adapting and some western companies are responding fast. Devi Shetty is applying Henry Ford management principles to hospitals to create economies of scale and specialisation and reduce the cost of heart surgery. The Narayana Hrudayalaya Hospital has 1000 beds, compared with 160 beds in American heart hospitals, and the team of 40 cardiologists perform about 600 operations a week. Sheer numbers of operations per surgeon mean that skills and expertise are up, and costs are down[10]. Open heart surgery in this hospital can cost $2000, rather than anything between $20,000 and $100,000 in the USA. He is now setting up a hospital along similar lines off the coast of Miami.

Tata Chemicals has developed a small, cheap, robust water filter which could radically reduce the 2 million or so deaths caused by drinking contaminated water in India alone. GE developed a hand-held electrocardiogram for emerging economies by simplifying the technology and procedures and reducing the size so that the device costs $800 instead of $2000; can run on batteries as well as mains power; and whose output device is like a ticket machine printer. ECGs now cost $1 per person.

These low cost approaches are moving from east to west, south to north. Cash strapped consumers and governments, health authorities and social care administrations will welcome them with open arms.

QUESTION: What are the implications for public interest and regulation?

- To what extent can Canada begin to implement and learn from these low cost models? How can the risks be weighed up relative to the benefits? Are there opportunities for insurance policies to fund 'overseas provision' of lower cost health care, at first in situ, but then remotely? [11]

- If health tourism continues to grow and in instances where quality and care is inadequate so that patients have major after effects, will governments need to foot the bill, or will consequences of personal choice and risk need to be set out? Will tighter controls be needed?

Population growth, imbalances and shortages

By 2030 there will be about 8 billion people on the planet; by 2050, 9 billion. In very general terms, the west is ageing - by 2050 one in three people in the rich west will be on a pension, but the rest of the world is still remarkably young, except for China. Her population will peak in the next few years, and will then begin to age because of her one child policy.

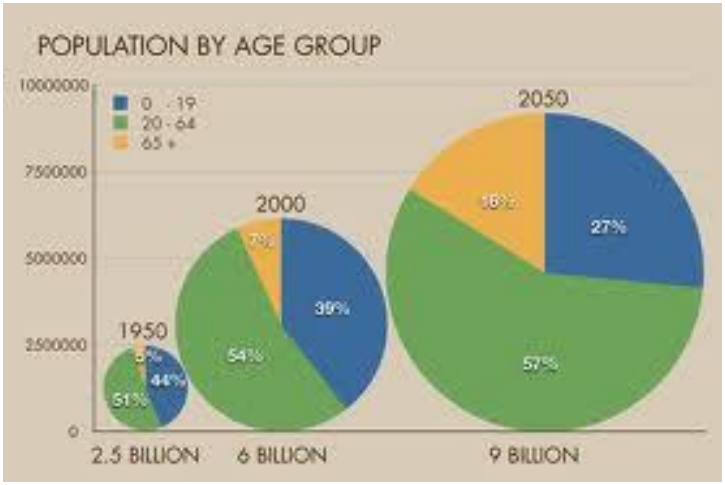


Figure2: World population forecast by age[12]

Feeding this growing world population is a major challenge. There are also growing debates and concerns about the role of meat production – because of methane and other Green House Gas levels – in climate change[13]. Meat production requires far higher levels of water and land resources, both under severe pressure globally, than other forms of nutrition. Meat consumption rises with sheer numbers, but even more so with increased affluence; the problems associated with meat production are set to grow and some are recommending reduced meat consumption and dietary change for climate change reasons alone. In the west overconsumption of meat is also a health issue. Diet, health and climate change, as well as agribusiness may be increasingly intertwined.

To illustrate the differences between the west and the rest, world average age is 28, but in Italy it is 43 and in Japan 44. In India it is 26 but in the Middle East and Africa it is under 20. By 2040, Africa and the Middle East will have the largest working age populations, about 1.1 billion people, all in need of gainful employment and a means to meet their own aspirations[14].

A combination of rising educational standards raising expectations, new technology enabling greater awareness of the world and lack of jobs is said to be among the main causes of the unrest in the Middle East and North Africa.

In the west, the issues surrounding ageing populations are well known and much discussed - the attendant costs of health care and pensions, declining dependency ratios and skill shortages. A new report from the NIESR in the UK[15] sets out the scale of the challenge in terms of tax shortfall. It has estimated that the current over 60s generation will each have a net tax gain of just under £250,000 over their lifetime, whereas the reverse is likely to be true of children born today. Redressing that

imbalance will need a further rise of £88bn in tax receipts. £88bn represents about 6% of UK GDP, almost 60% of total annual income tax receipts and 16% of total tax receipts.

A variety of responses is being put in place including later retirement, less generous pensions coupled with more contributions, 'the big society', greater reliance on family and voluntary sector for support, the development of telemedicine and service robots.

QUESTION: What are the implications for public interest and regulation?

- How will governments balance the different demands and needs of individual health and choice, with global risks of climate change, and the significance of meat in the food sector? Could we see mechanisms or incentives to 'encourage', although not proscribe, dietary changes? How well equipped are government departments for such interdisciplinary issues?

- Canada's overall population is forecast to grow, but predominantly among the over 30s, and in particular the over 60s. Only medium high growth population projections anticipate any growth in younger age groups. Will the combination of more accessible land, potentially large numbers of migrants worldwide for a variety of reasons and perceived quality of life make Canada an attractive option for immigrants? Would the economic benefits outweigh the perceived and actual costs? Which might serve public interest best?

Aspirations and quality of life in cities rising

By 2020, an estimated 1 billion additional people will have disposable income, becoming consumers for the first time[16]. Mobile phones are one of the biggest growth areas in emerging markets providing not only a chance to talk, but mobile banking, information about crops and agriculture, games and education. In short, new opportunities for economic development and new markets are arriving[17].

Other changes also come with affluence. Television is seen as old media, but about 140 million people will become new viewers in 2011. Likewise, air conditioning is a new essential to surviving in many emerging nations and in China alone some 20 million units are sold every year[18]. A third focuses on diet, in particular more meat but also many of our western bad dietary habits such as too much fat and sugar and the attendant impacts on health. Again, all bring major opportunities for economic growth, but all of which will also mean greater pressure on agriculture, energy and natural resources.

Those aspirations are also driving a move to cities and a desire for a better life. We are already living in the world's first urban century – more than half of us live in cities: by 2050 that will have risen to 70%. As a result, cities are getting larger and more numerous. China already has over 150 cities of more than 1 million inhabitants, compared with 9 in America and 25 in Europe. By 2025 that number is expected to have risen to about 220.

But while cities the world over are facing challenges of congestion, air quality, and quality of life, they are also better placed to reduce per capita carbon footprints. New smart city projects are aiming to create radically new approaches to city living, improve mobility, reduce carbon footprints, and increase walk-ability. Korea is investing heavily in 15 'ubiquitous' cities; smart city projects such as Masdar aim to prove what can be done; Cisco is investing heavily and sees a $30 billion market.

Quality of life will be critical in attracting highly skilled workforce in the future. New research has indicated that location is a critical factor in job acceptance for 64% of those who could be described as top talent or elite knowledge workers. Companies located in cities which are good to live in, offer diversity of culture, character and opportunity will win. Canada is well placed. According to the latest Mercer Quality of Living Survey, Canadian cities perform well both globally and within the Americas with Vancouver 4th globally, but top in the Americas, followed by Ottawa 14th, Toronto 16th and Montreal 21st. Calgary ranks 28th on the overall quality of living ranking, but tops the new global ranking of eco-cities based on water availability and drinkability, waste removal, quality of sewage systems, air pollution and traffic congestion. Ottawa is joint 3rd on eco-city ranking with Helsinki[19].

QUESTION: What are the implications for public interest and regulation?

- To what extent should health become a more significant factor in city planning and building design – e.g. walkable communities, safe street environments? How can arguments about additional costs be overcome by demonstrating the long term savings and benefits elsewhere against the short termism of politics?
- To what extent can major infrastructure investments be justified when debt levels are already high?
- How can Canada ensure regulatory frameworks which build in and retain current forms of quality of life, while also capitalising on new developments?

Pollution meets public health

Pollution may be having a far greater and longer lasting effect on our health than we realised. New research, while not yet conclusive, indicates potentially strong links with obesity, intelligence, autism and cancer.

Research in Spain examined a potential link between foetal exposure to the pesticide hexachlorobenzene and obesity. Having measured the levels of the pesticide in umbilical cords of 403 children they then compared obesity levels at aged 6. Those with the highest exposure were more than twice as likely to be obese than those with lower exposure.

Research exposing mice to different levels of air pollution, which was the equivalent to exposing a child from being a toddler to late adolescence, indicated a significant increase in likelihood of Type 2 diabetes and increased levels of fat in blood cells. This included exposure to particulate matter of 2.5 microns or less, which can penetrate deep within biological systems.

Another research project monitored pregnant women's exposure to air pollution in low income areas of Manhattan and the subsequent cognitive development of their children. It indicated a link between high exposure and lower IQ, whereby those with the highest levels of exposure had IQ levels 4.3-4.6 points lower than those with lowest exposure. These differences included taking other variables into consideration.

A project in California examined 959 children born in 1994: 284 of who were subsequently diagnosed with an autistic spectrum disorder. Those born in areas of high air pollution, especially mercury cadmium, nickel, trichloroethylene and vinyl chloride, had a 50% greater likelihood of a diagnosis.

In the U.K. the first globally successful lawsuit was brought against Corby Town Council for neglect in polluting the environment with asbestos causing child birth deformities 30 years ago! Scientific evidence of pollution in the child was shown to come from this asbestos and is a weak signal of how regulations and legal issues may need transforming in the decades ahead.

Direct links and therefore causation are not always fully clear yet, but these findings will change the nature of environment and public health debates, regulation and responses, as well as potentially affecting house prices and driving demand for clean technologies.

QUESTION: What are the implications for public interest and regulation?

- If air pollution is shown to be a significant factor in obesity, cancer, autism and reduced intelligence – will governments be sued for not acting to clean city air?

- If air pollution becomes a more tangible issue – i.e. combines with concerns about health, and especially children's health, how can governments use this to motivate people to change their behaviours about car use, to justify infrastructure and clean technology investment?

- If it is increasingly possible to identify the precise source of pollution affecting individuals, and potentially causing serious health problems, will there be greater litigation and will governments need to implement clear polluter pays policies?

Resource pressures and peakonomics

World resources are under pressure as populations grow, economies develop and much of the west continues to consume at a rate the equivalent to that of 3 planets worth of resources; 5 planets worth for the USA[20]. Oil, water, coal agricultural land, quality of soil, phosphates, lithium, neodymium – to name but a few that have all been described as 'peaking', i.e. that easily accessible supplies are rapidly being exhausted[21]. The EU has drawn up a list of critical high tech industry resources where supplies are vulnerable and for example where China has a dominant position and been willing to restrict supplies – most recently of rare earths needed for clean technologies and ICT sectors.

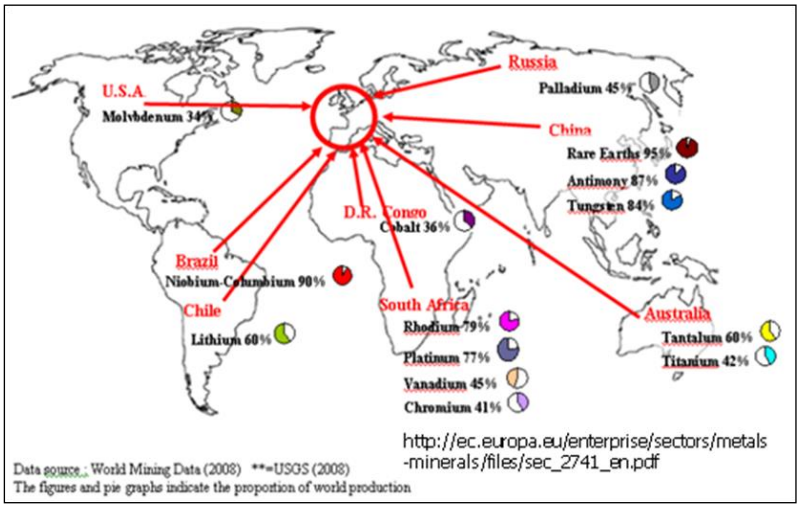


Figure 3: Global supplies of 'high tech industry' minerals and metals

Whether or not we have passed peak oil, or when and even if it will occur have been part the wider debate on resources for some time, what is agreed is that demand will

grow and prices will rise. World energy demand is forecast to grow by 44% from 2006 to 2030, according to the Energy Industry Administration. Forecasts of oil costing $300 a barrel by 2020 are becoming more common[22] and in the wake of the recent price rises in response to North African unrest and the price spike in 2008 of $145 a barrel, more likely. New supplies and new technologies will undoubtedly have a role to play, but resource depletion and shortages are part of our future, unless we can find radically new solutions and are encouraged to change our ways.

Resource pressures are here to stay. Finding ways to encourage / ensure best use of resources now and in the future that will meet the diverse needs for growth and sustainability remains a challenge. There is a debate about the need, even in these straightened times, to borrow against the future in order to invest in cleaner technologies and infrastructures for the benefit of all.[23]

QUESTION: What are the implications for public interest and regulation?

- Major companies are making significant investments to reduce carbon footprints and resource use. How can governments ensure that services such as health care are as green and sustainable at every level as possible?
- What combinations of incentives and controls can be used to achieve the levels of radical innovation and behaviour change needed?

Recessions, shocks and mortgaged futures

The levels of debt in individual economies from national governments down to individual consumers are enormous. Canada escaped the worst of the financial crisis, its banks were less exposed to toxic assets than most, and bail outs were not needed. But while Canada is better off than many, there are problems and it is part of a global economic system in which the levels of interconnectedness, instability and domino effects have been demonstrated only too clearly in recent years.

Canada's national debt stands at $1.1 trillion, approximately $32,506 US per capita.[24] This per capita debt is higher than that of Greece -$35,403, Ireland- $28,758 and Portugal - $18,959. Consumer debt is also running high, and getting higher. It topped $100,000 per family recently, and debt to income ratios are running at 150%, or $1500 to every $1000 earned. Levels of household debt and the need to curb them and inflation could result in radically reduced consumer spending and a downturn in the economy in the short term[25]. Major external shocks could turn a mild contraction into another major global recession.

And shocks are waiting to happen. The ongoing instability in the Middle East and any attendant major shortfall in oil could spark a sharp price increase in oil, which in turn could trigger a global recession. The Euro zone is still not as stable as many

hoped, and further defaults and consequences could occur – such as a major shift in the structure of the EU. The disasters in Japan are still unfolding: how far and how deep those repercussions will go is unclear. Further physical earthquakes may lie ahead – major earthquakes trigger more major earthquakes – sending global tremors which act as the 'final straw' on other pressure points. What if the next one occurred in Silicon Valley, with an associated mega tsunami and nuclear disaster but on a scale more akin to Chernobyl[26] [27]

QUESTION: What are the implications for public interest and regulation?

- How crisis proof are Canada's services?
- How would Canada's health service respond to a 25% cut in funding?

Everything is connected, smart, digital and trackable

In future, everything will be connected, intelligent and trackable. The internet of things will be here; the era of smart everything will have arrived. Machines will talk to machines; humans will interact with machines; machines will keep track of things; machines will keep track of humans; oh, and humans will interact with humans. Our homes, our clothes, our cars, our dustbins, our infrastructures… everything will have embedded intelligence and connectivity, plus the ability to monitor, interact and send messages, be programmed, interrogated and data analysed. By 2020 we are likely to have about 50 billion different devices connected to the internet; possibly more[28]. ICTs and smart technologies could radically reduce our energy use, need to travel and where and how we grow things.

As with most major developments a number of technologies have come together. RFID tags enable us to keep track of anything they are stuck to – like our online orders from Amazon. Moore's Law continues to double the speed and capacity of chips which are at the heart of all ICTs and keep the power size ratio going. Nano materials, quantum tunnelling and now lithium ion printable batteries keep the power use of devices going down and storage going up. Cloud computing enables even the smallest devices to access programs, huge data capacity and use complex processing. The size of the internet is growing exponentially and its number of connections will soon exceed that of a human brain, making it always on, ever present and increasingly 'intelligent'.[29]

With this growing power, distributed and embedded intelligence applications are growing. Affective technology is helping machines understand us[30], read non verbal communication so that cars, such as the new top of the range VW Passat, can now monitor and prompt drivers, if they appear to be getting tired at the wheel, that they

should take a rest. Embedded sensors help people park their cars and prevent minor bumps; soon they will enable auto drive cars[31].

But one of the biggest applications will be the smart home. Energy efficiency, security and other infrastructures are attracting huge investments. Whirlpool has already stopped making 'dumb' appliances and by 2014 will make only intelligent ones[32], Google and others are investigating smart meters for reducing energy consumption. One of the critical areas of opportunity in the smart home is for elder care and health care.[33]

Intelligent toilets can analyse human waste for problems; motion and floor sensors differentiate between a sleeping dog and a fallen elderly person; clever pill boxes can monitor pill taking; blood and heart monitors can transmit regular checks on vital signs; fall monitors can anticipate falls and call emergency services. The list is endless, and that is now. Investment in research and product development is high. The need to find alternatives ways to support older people, extend independence, reduce isolation and loneliness, and reduce costs are huge incentives for research into what is seen as a potentially huge market. Medical research may be outmanoeuvred by the speed of developments in consumer appliances, TVs, wifi and mobile related technologies.

Robots are perhaps a more extreme manifestation of smart technology, but they are coming. Robots in the home are some way off, although South Korea has set an objective of one in every home by 2020. Nevertheless, robots are moving out of the factory into the pharmacy, the kitchen, the hospital ward and the office. Japan is investing heavily in care robots in order to address skill shortages.

QUESTION: What are the implications for public interest and regulation?

- How well placed in Canada to develop and introduce smart technology and even robots into health and care to address skill shortages and potentially reduce budgets?
- Who would pay for the investment to install such technologies in people's homes? How might the state recoup such costs in order to balance the books and the benefits?
- What training is needed to encourage health and care professionals, many of whom are unaware of the options or technology's potential, to implement and encourage the uptake of radically new solutions?

- What safeguards and regulations concerning privacy and security may be needed?

- The use of virtual surgery, robots and new forms of medical equipment and the use of non-medical equipment to support health will require radically new forms of regulation.

The power of the mobile rising

We live in a world of 24 hour news; always on Instant Messaging, social networking and chat rooms; crowdsourcing and collaboration; information, misinformation, disinformation, rumour, opinion and propaganda; secrecy and total transparency. The speed at which ideas can be shared and transmitted to exponentially growing numbers, or within a group of specifically interested individuals, is measured in minutes rather than hours.

The scale of this content connectedness is growing as the internet goes mobile, and the world's phones go smart. Currently an estimated 500 million smart phones are in use; by 2015 that is expected to reach 2 billion[34]. The total number of phones currently connected to networks is put at 5 billion, with Africa and parts of Asia some of the few remaining areas where less than 50% of the population owns one.

Smart phones are also opening up whole new uses and applications – apart from sharing photos and watching TV or videos. Apps have revolutionised how we can personalise our phones, and adapt them be an ever more integral part of our lives. So far 10 billion apps have been downloaded from the Apple App store[35]; Android phones are overtaking Apple in terms of numbers of apps downloaded. Apps are also moving to the TV – Samsung has recorded 2.5 million TV app downloads[36]. At present, there are approximately 17,000 health related apps available, and a recent report suggests that by 2015, about 1/3 of smart phone users will access health information / care related apps[37].

Mobile phones' popularity, convenience and omnipresence in our lives will enable and speed up acceptance of new applications. They are becoming an extension to our selves, providing a portable ever present data bank of who we are, what we like and what we may want or need. Extensions to mobiles are turning them into microscopes and analysis tools tracking pollution, helping in research, providing remote health care services[38] [39]. At the moment most apps are static, but soon they will be able to incorporate our own personal information – records at first, but then biological or genetic data. They can also be an emergency device, a means to keep confused elderly people safe, providing instant access not just to medical records but perhaps our very being – our genome and more.

In terms of wider media and transparency, this highly connected content changes the rules. The uprisings and demonstrations in North Africa were enabled and organised via Twitter and other social networking sites. The recent protests against companies such as Vodafone for non tax payment likewise[40], and the hacktivism attacks such as those against Amazon and PayPal- who were regarded as having undermined WikiLeaks[41] - all were organised and enabled by smart phones.

This content connectedness also brings problems of balance, verification, speed of response, reputation management for individuals and organisations – to name but a few. Wider issues such as personal privacy, cyber-security and identity theft will be even more critical as the range and depth of information and services on phones expand.

QUESTION: What are the implications for public interest and regulation?

- How well prepared are health and care providers for a hacktivist attack? How disruptive would denial of service or interruptions to communications be on health and care provision?
- How can the Canadian Government use these new communication media to best advantage?

Extending layers of reality

We are entering a world where the boundaries between different layers of reality are blurring, where we can enjoy events, experiences, skills and abilities – such as polo ponies jumping through the front of buildings, going jogging anywhere in the world, or people being able to fly - that are impossible in our own world.

Real reality (RR) can be extended or enhanced by Augmented Reality (AR); whole other worlds have been developed for gaming and training, and increasingly medical treatment, which are totally virtual (VR). Teleconferencing is becoming telepresence with enhanced images and soon holographic images to bring people into the room together. Holograms of security staff are appearing in airports to try to encourage passengers to remember to dispose of liquids before security checks. 3D films, TV and gaming devices are becoming commonplace. Haptic technologies are enhancing our digital experiences with touch, smell and other sensations. Soon we will be able physically to interact with holograms almost as though they were there – even to the point of dancing with one.

VR in healthcare can help speed up the healing processes of burns victims – by using snow scenes; reduce stress and improve mood in depressed patients by changing the decor and view. Medical facilities have been recreated in Second Life to help trainee

doctors learn and practise. Online gaming helps people learn to collaborate as well as fight, and has been shown to develop skills of persistence and determination.

Given that these capabilities are probably being produced with the computing technology equivalent of a 1930s or possibly a 1950s TV, relative to what the immersive and interactive capabilities will be in the future (think Star Trek Holodec) the future potential of these layers of reality in training, health care, work and leisure are enormous. With the growing sophistication and availability of brain computer interfaces these worlds could be intuitive, personal and all encompassing.

But there are also dark sides. Even with these low levels of altered layers of realities, concerns about addiction, transfer of aggression from virtual to real worlds, altered brains and thinking are rising.

QUESTION: What are the implications for public interest and regulation?

- How could virtual worlds be used to 'create' and provide health services as well as healthier living environments in remote regions? Or in regions where climate made living conditions challenging but necessary e.g. if the Northwest Passage were open some of the year and the development of arctic resources grew? For example, underground cities are being explored in Siberia[42].

- To what extent might the growing concerns about how computer use is changing our brains lead to demands for greater controls of augmented or virtual reality use and applications?

Profiling the personal

Science is digging deep inside the workings of the human body and mind, changing our understanding of how things work what causes illness and potentially how to cure, or better still prevent many of the major lifestyle related, fatal, chronic or degenerative diseases that afflict us.

Neuroscience is changing our understanding of the brain at what feels like breakneck speed. It can now recognise where different types of thoughts occur, find ways to reprogram parts of the brain to take over lost functions, and help insert chips to enable stroke victims to speak again. We may soon see the use of a combination of neuroscience and other techniques – drugs, sleep, diet, surroundings etc to enhance the memories and capabilities of individuals who are healthy, rather than only to heal the sick[43]. Marketers are already using neuroscience to understand better what messages work on different groups to best effect and so fine tuning advertising and promotions.

Brainwave interfaces are also make huge strides. Research continues into the use of brainwave and nerve based controls for prostheses, wheelchairs and 'techno-trousers' to assist walking[44]. But brain/ thought controlled equipment has already moved from the research lab to gaming devices, the mobile phone and the iPad. Soon we are likely to see brain controlled home appliances.[45] While the interface is important in itself, it may also enable radically new approaches to 'brain training', which the popularity of devices such as the Nintendo DS have demonstrated.

Likewise genetics is revealing genes that increase our susceptibility to numerous conditions including obesity and cancer. This progress coupled with the increasing speed and ease, and therefore falling price, of mapping individual genomes is giving rise to fundamentally new approaches to health, medicine and research.

One such result is the emergence of citizen science. Individuals willing and able to 'experiment' on themselves are using a combination of self interest – e.g. a man who has early signs of dry macular degeneration- plus cheap genetic profiles costing $500, and the mass of information on the internet.[46] However, just as citizen science can be for the public good, it can also be for public evil or even terrorism.

Then there is proteomics. Mapping the whole proteome may make mapping the genome look relatively easy, but its benefits may be that much greater. By 2030, we may see the $500 equivalent to personal genome profiling.

Separate, but also important are the developments in nanotechnologies which will allow us to monitor the workings of the human body in real-time from the inside, potentially sending tiny targeted robots and personalised drugs to the right spot.

By 2030, we may all be carrying our genomes on our phones combined with other vital data so that in case of emergency or on a visit to a drop-in health centre or even the supermarket we can make sure that what we do suits what we want to achieve. Biometrics such as voice prints and brain waves or vein maps may be needed to protect this highly personal data, since they at present, cannot be forged[47].

QUESTION: What are the implications for public interest and regulation?

- To what extent should citizen scientists who experiment on themselves then share results be 'allowed to get on with it'?
- How effectively can the use of profiling services be controlled as they become cheaper, more detailed and more widespread, given that they can advertise and reach customers globally?

- Screening for genetic selection e.g. in IVF treatment is illegal, but as our knowledge of the workings of the brain increases, will we see demand for 'ability enhancement' to address skills and talent shortages, or simply for personal gain? How will regulators define the boundary between selection and treatment? How would the likely gaps between haves and have-nots that this would encourage sit with Canada's values and more collective identity?

- Where are the boundaries between we can and we should, as more and more new technologies emerge which delve into the inner workings of the human body? Who should decide?

3D printing from fashion to food to organs to.....

3D printing creates objects line by line, layer by layer using a printer not totally dissimilar to the ones found in most offices and homes. They can use a growing range of materials including glass, plastics and metals, and soon also foodstuffs and cells. The accuracy with which they are able to transform a design into a final product is growing and the price of the equipment is falling, some now cost as little as £10,000, although the more sophisticated ones still cost £100,000s.

3D printing helped revolutionise prototyping, reducing costs and timeframes. The same quantum changes may soon be felt in manufacturing and even healthcare.

A range of applications and developments involving high end designs and manufacture, services which create bespoke products for consumers and research projects into new applications such as 3D printed food are helping raise familiarity, improve sophistication and create acceptance.

Work on 3D printed prosthetics has been going on for some time, but more recently, researchers at the Institute of Regenerative Medicine are developing a system that allows them to print skin directly into burn wounds. The work has come out of the need to treat battle injuries in Iraq and Afghanistan[48] [49] [50].

If, as is increasingly possible, health specialists are soon able to reproduce our cells 'to order' without resorting to using stem cells and then print organs on demand, transplant surgery waiting lists may become a thing of the past. The success rates may also increase radically as rejection rates reduce.

QUESTION: What are the implications for public interest and regulation?

- Could we see increased demand for cell harvesting and storage and how would that be managed and regulated? By whom?

- Will members of the armed forces be required to store cells to increase the potential for treatment? Other risky professions such as fire fighters?

Generation effects

Generations who grow up with shared experiences can be seen as having similar or shared characteristics. The marketing industry in particular has developed the concept, but it does provide a useful framework for thinking about how different sizes of cohorts and their attitudes could and will shape the future. The Boomers – those born up to the mid 1960s have led the revolution from the front, demanding change and defying the rules. Increasingly they are also seen as potentially bankrupting the system and passing on debt to future generations. Gen X those born till about 1980, are quieter and fewer, heads down and settling down – seen as rejecting the ways of their parents. Gen Y or the Millennials, born up to the early 1990s, are again making waves with new demands for independence and opportunity especially in the workplace. And finally Gen C those who have grown up in a truly digital age and are connected, content oriented and collaborative. These young people just entering the workforce will be the ones to inhabit and shape our connected worlds[51] [52].

Then there is the lost generation- those whose transition to adult working life is stalled before it starts. Unemployment rates among young people are far higher than the average in the workforce, some times as much as 2 -3 times higher, and Canada is no exception. Average unemployment is just over 8%, youth unemployment nearly 16%[53]. The impacts are not just in the present. People who experience unemployment when young tend to have more health problems, poorer family relations, lower self esteem, earn less once employed – not just when young, but throughout life.

There has in the past been a general expectation that future generations 'will be better off'. While the current return of consumer confidence in the wake of the recession is encouraging, there are signs that overall faith in the future is declining[54]. Our awareness of global events, the constant buzz of 24 hour media, and the seemingly never ending stream of bad news have created a sense of fear both specific and unspecified. Coupled with this are the health problems which affluence, more static lifestyles and poor diet are storing up for future generations – who may for the first time ever die younger than their parents. Elsewhere research indicates that while we may be pessimistic about the big picture, we often think our own futures look much better.

Innovation, entrepreneurialism and change require a level of energy and drive. Just as consumer and business confidence is critical to the economy, so a sense of hope and optimism is critical to making the future work for all of us.

QUESTION: What are the implications for public interest and regulation?

- How could governments respond if younger generations actively resent and refuse to have their futures mortgaged to pay for health care for the boomer generation?
- How will governments balance the short term protests of current generations, whose access to care, pensions etc may be curtailed if radical changes are introduced, with the need to be fair to future generations?
- How can the costs – personal and financial – of long term health issues arising from youth unemployment be mitigated? How can investment in job creation or enabling contribution be offset against health benefits? Should alternative forms of contribution be required, on health grounds?

New metrics, new meaning

In recent years we have seen a change in metrics. Given the old adage of what gets measured counts, these changes are important.

The uptake of Corporate Social Responsibility and the popularity of fair-trade goods are corporate and market manifestations of new metrics. Most major companies now set great store by their CSR reports as well as their economic results; they are also increasingly judged on these softer measures and their values by prospective employees as well as their customers. Fair-trade products have moved from fringe to mainstream as supermarkets and food producers rush to source sustainably and fairly – and tell the world about it. In the UK alone fair-trade sales grew by 40% in 2010 to an estimated retail value of £1.17bn compared with £836m in 2009[55]. Then there are the additional philanthropic activities, such as donating money for every dollar or pound spent.

At a government level, in 2008 the French President announced the intention to explore Net National Product as an alternative to GDP for measuring economic success and wellbeing[56]. Recently, the UK government has also been discussing the development of a similar index, and using the impact of policies on personal wellbeing and happiness as a yardstick in assessing their potential.

As we move to worlds where full time employment and full employment may be rare commodities, redefining how we measure success at an individual level as well as corporate and national levels will be important. Contribution rather than purely earnings, social capital as well as financial capital, intangible outputs as well as tangible ones will need to be recognised and rewarded.

Local economic trading schemes may be a model for the future, where communities can co-create, value then barter and exchange everything from walking someone's dog or having access to someone's garden to grow vegetables to helping maintain and run a local shop of leisure activity.

QUESTION: What are the implications for public interest and regulation?

- How can government departments create genuinely interdisciplinary, cross government department responses to these complex issues?
- The boundaries between public, private and voluntary sectors are blurring as new approaches and new measures of success emerge: how well equipped is government to respond to and regulate this new world?

Anticipated capabilities

The following examples draw on the changes and trends touched on in the previous section to illustrate possible directions of change, but also issues, challenges and opportunities which could arise. They are not scenarios, more like informed 'vignettes', which draw on Shaping Tomorrow's extensive experience and work in futures as well as the specific trends and developments highlighted above. The aim is to suggest how changes affecting the wider context - business / policy / social environment - could change aspects of public interest relating to health care. This in turn, will affect the need for and approach to regulation. At this stage we are raising questions, rather than providing answers.

Ration or revolution: avoiding a healthcare cost tsunami

A recent report from McKinsey estimates that US health costs have grown at 4.9 % every year for the last 40 years, and currently represent 16% of GDP. Given that GDP growth over the same period has only grown at 2.1%p.a., theoretically health spending could equal 100% of GDP in 100 years[57]! Change is needed to address the rising costs of chronic health problems.

Disruptive technology innovation could have the power to transform the costs and capabilities of health care, as it has and does in other sectors, so that abundance can replace scarcity, accessibility can replace rationing – if we draw on the principles and approaches espoused by Bob Metcalfe[58]. However a range of factors can distort and prevent innovation for the greater good: the interests of different stakeholders – doctors, public/patients, unions, providers, government; risk aversion plus irrational expectations to remove all hazards; the historical legacy and ethos, principles and

values embedded both in the service and the public attitudes to health care provision; levels of debt and lack of capital for investment.[59]

The constraints faced by developing nations may result in approaches which provide the lead to the west. What balance of incentives and regulation would be needed?

From 'cure me' to contracts and incentives?

At present, there is an assumption that if I am ill, even if it is 'my fault' e.g. lifestyle, diet etc are major factors, that health care will 'cure me'. Even if health care were abundant, is this ethos and expectation justifiable, viable or desirable? Whose interests does it serve? And should it be changed?

As we understand more and more about personal risk factors and predisposition to specific diseases or conditions, can monitor more and more activities and information in real-time and understand the consequences of personal choices, will increasingly be able to prevent or at the very least identify very early signs of problems, will health systems move to a win: win of health enabling, rather than curing? Will that perhaps be on the basis of incentives, harsh realities and conditions?

In a programme which started in Mexico, but has achieved huge success in reducing poverty and the effects of poverty in Brazil and is now operational in 40 countries, poor families are paid a small amount when they meet certain conditions[60]. Raymond McCauley, an individual who investigated his own macular degeneration as a citizen scientist, also radically changed his diet when confronted with the genetic 'proof' of his vulnerability to heart disease as a result of a genetic profile; till then, exhortations from doctors to change his ways had not worked.

How might the ability to warn people about genetic predisposition affect behaviour, and would the cost of profiling and advice, coupled with clear incentives across a range of areas, not purely health related, outweigh the benefits? Given the known benefits of work and constructive contribution for health, under such circumstances how might citizens react to the state's responsibility for but possible failure to provide, overall economic conditions conducive to job creation?

Are we moving to a world where explicit terms and conditions are regulated and built into service provision?

From no frills airlines to no frills care?

Consumers and businesses alike have recognised the benefits of no-frills airlines, which have opened up air travel routes and opportunities to many more people. Consumers voted with their feet when the costs were clear and the main benefits the same - you get there. The clear and tight regulation and safety standards mean that

air travel is still the safest way to travel. Could the same principles be applied to health care? Is no-frill, low cost necessarily poor quality? If costs were made explicit, not hidden in 'free at the point of access', could the balance of use, misuse, over-use and expectation shift?

In India, investments in new hospitals and large scale 'factory production line' approaches to surgery have not only reduced costs, but improved skill and outputs. What are the barriers to achieving such approaches? Status and image of surgeons? Tradition? Lack of opportunity for new suppliers because of barriers to entry?

Today, patients who want cheaper or quicker care and operations will often resort to health tourism. Sometimes the results are complications which require more costly treatment back home, or trafficking in organs and blood in the emerging country. But, as the range of high quality medical treatment in places such as India grows, could insurance policies provide no-frills, overseas solutions, from approved lists? Longer term, will health care - home and hospital based, diagnosis as well as treatment, become international as remote access monitoring, testing and reviewing, and even operating create totally different approaches and cost models?

Business model innovation is often the most effective form of innovation, but requires systemic change. New technologies, such as tele-everything, provide the means. Cost crises create the incentives. Removing the barriers is increasingly important. Effective regulation that creates the right balance between enabling and protecting, personal choice and risk/ cost reduction will be a challenge.

Quality, cost and complex supply chains[61] [62]

Companies, including health care providers and pharmaceutical companies, service commissioners and consumers are constantly looking for best cost options. Increasingly complex global supply chains are needed to compete effectively to meet that challenge. With those extended supply chains comes the growing risk of problems, poor quality and serious consequences for individuals, even deaths. And it is not just in health care – quality control in a world of ever greater competition and more complex supply chains is increasingly difficult: Toyota famed for its quality has had major problems – with more recalls in February 2011 bring the total since 2009 to over 12 million cars[63], BP's reputation – and almost its very existence, has been dashed by disasters, Google invaded people's privacy with its Streetview cars, Mattel had numerous recalls of products made in China, Cadbury's found salmonella in its chocolate, Maclaren buggies had design problems which 'trapped children's fingers'.

The numbers of incidents continue to rise. In the UK, 2009-2010 witnessed the highest ever number of all product recalls. In 2009, in America, there was a 300+% increase in drug recalls, with a total of 1742. Although known fatalities such as the

100 or so deaths as a result of contaminated Heparin in America are relatively rare, the likelihood of more is increasing. As more personalised medicine becomes the norm, the nature of those risks will change.

Small government, lower taxes, less red tape and regulation are all seen as essential for greater economic competitiveness and long term economic success. Long lead times on drugs, because of stringent testing of food and drugs, are often seen as onerous and behind the curve – often too little too late! Consumer demand for new solutions and access to the latest cures grows. The need to balance competitiveness, cost effectiveness and quality is becoming more challenging.

As treatments become more personalised and tailored to genetic profile or other factors, not only will drug development and use change, but so too will the boundaries of responsibility and definitions of what the 'drug' is, bring further complexity to the issues and the necessary regulatory framework.

Embedded intelligence and new levels of analysis

We will be able to collect, monitor and analyse data to inform processes and decisions in radically new ways as a result of embedded intelligence and sensors, advances in processing capacity and even citizen science. In-situ intelligence will enable automated safety and support. A mass of data will not only be available for research and policy on an aggregated basis, but in real-time and on a cumulative personal basis.

Risk management and introduction of such concepts as Best Before dates have undoubtedly brought major benefits; they have also introduced huge wastage and potentially an over-reliance on BBE rather than common sense, and our five senses to detect problems in food. Drug wastage is equally a major issue. As sensors and chips become cheaper then packaging could have embedded intelligence along with everything else. Vitality recently launched their AT&T enabled intelligent pill bottle which can send reminders to patients to take their medication.[64]

As chronic health problems increase and older people face taking a growing number of drugs at different intervals, the need for such devices will increase. They will be able to ensure that not only are the prescriptions taken but that they are taken correctly. Families and medical staff can also use the data to reassure themselves. The same technologies could be used to ensure freshness in food, ingredients and quality control, security and tamper indication – among other applications.

The direct correlations of the impacts of pollution on lowering intelligence, potentially triggering obesity, cancer and autism, have yet to be fully verified. However, exposure to chemicals and pollutants is a real issue. Another recent, but as yet not proven piece of research highlighted the potential link between wifi radiation

and significant leaf damage on trees: if it damages leaves what might is be doing to humans? Allergies are also becoming more widespread, people feeling more vulnerable.

In future, embedded intelligence and sensors will enable not only separate research studies to capture and analyse pollution levels in areas, but individuals could convert their phones into real-time monitors of their own personal exposure to chemicals and cocktails of chemicals – in cities, the workplace, at leisure in the home. Such masses of data could provide both significant protection but also lead to significant cost if polluter pays principles are enforced.

Disease outbreaks or other health emergencies such as an incident of salmonella poisoning could be tracked in real-time far more rapidly. The 'Outbreaks near me' App for the iPhone launched in 2009 had 100,000 users within three months and helps map outbreaks in real-time updating information hourly. As more real-time information is available more support to interpret the real dangers and risks will be needed.

Given the unreliability of health related information on the web, how can quality of data be guaranteed?

We may see a move away from overly detailed regulation to a much simpler set of rules and guidelines backed up by in-situ, real-time monitoring – akin to the 'black box ' in planes or taco graphs in lorries – which can enable random checks and analysis. Just as Apps will be used in health care, they may also be part of the regulation of care.

Privacy- what's that?

We have grown used to Sat-Nav and location based services and offers via services such as Groupon are increasingly popular. These services already require a level of transparency about our interests, behaviours and location that many are unaware of, but are happy to benefit from: convenience and fun win out over security and privacy. Added to that is the willingness of the Facebook generation to share their lives with the world[65].

As Kevin Kelly pointed out in his talk about the future of the internet, levels of connectivity will grow exponentially. That connectivity will in turn enable levels of personalised service that we cannot yet imagine. Most of that connectivity will be via mobiles or embedded devices. The level of personal data likely to be stored on mobiles, or other embedded devices that are carried around, is growing.

Increased levels of transparency may also lead individuals to recognise and wish to own and capitalise on the value of their own personal information to a far greater

degree. 'Personal value-banks' the research and commercial value inherent in our genes, lifestyles and health – or other personal data – will need trusted providers of protected repositories and controlled access. New services may emerge to hire out this wealth of personal data.

Privacy could become a thing of the past. The trade off will be in terms of personalised services, real-time support, and much easier lives. Ensuring security and identity protection will be a critical function of regulation, systems/ device design and effective personal usage.

Cybercrime, terrorism and other systems vulnerability

There are growing concerns about the growth of cyber crime, the use of cyber attacks not only as part of organised crime but as part of state sponsored attacks and terrorism, and that the targets are shifting towards industrial or infrastructure installations as well as personal identity and fraud. Hacktivist attacks – i.e. coordinated consumer initiated cyber attacks - also make protest led attacks or false information/ leaks on a number of issues simultaneously a potential threat to organisations[66] [67] [68] .

As our lives become increasingly reliant on integrated smart systems, computerised controls, embedded intelligence so systems vulnerability grows. Disaffected employees or patients could malign providers, leak confidential information or encourage targeted hacker attacks; terror organisations could target, or simply threaten to target, critical infrastructures to cause maximum chaos and damage; power supplies and communication systems could be knocked out as a result of knock on effects of other blackouts or systems failures.

How well prepared are back up systems, security and other critical infrastructure contingency plans? What would happen to remote monitoring of health systems in such circumstances? Who would be responsible if operations, scans or diagnostics were underway remotely and systems failed or disrupted data and connections enough to interrupt accuracy etc. Where would responsibility lie and how could providers prevent such difficulties.

A recent NASA report outlined the disastrous effects a major solar flare could have on power systems – knocking entire regions out and burning out critical plant which would take months to repair.[69] Such widespread blackouts would result in total shut down of life as we know it in the west, after about 24 hours when emergency power systems ran out. While such a major disaster is not very likely, NASA has reported major disruption to satellites and radio signals from solar flares recently[70], and Quebec suffered major blackouts in 1989 for the same reason.

Canada will be increasingly vulnerable to external attacks. Coordinated protection between different government departments, between governments and companies, organisations and consumers will create a complex context within which to balance secrecy and openness, collaboration and control and set the boundaries of responsibility and regulation.

Tolerance and intolerance rising?

Canada's culture is traditionally open and tolerant. But, just as the new media environment and new technologies will encourage greater transparency, they may also encourage more entrenched and less tolerant attitudes. More personalised news, more focused and concentrated lifestyles and more opportunities to talk and communicate with people whose opinions match rather than challenge your own, could result in greater intolerance.

'The truth is irrelevant'; people's perceptions of the truth drive actions and opinions. Public perceptions of risk versus realities are often distorted. So too are their expectations of science, the speed at which new discoveries or developments are likely to be available, and the wider implications and impacts. A narrower more concentrated basis for their opinions could make intolerance grow and more difficult to overcome.

Canada has been less vulnerable to extreme protests on such issues as stem cell research or abortion compared with those that have taken place in America. But protest tactics, e.g. of animal rights activists, are becoming more violent and aggressive. As cyber-attacks and protests become a 'weapon of choice' among protestors, could Canada be vulnerable to other countries' intolerance and protests even while their own tolerance continues?

If greater numbers of immigrants arrived from more radically different cultures and with radically different views, could Canada's capacity to absorb them be reduced? Could intolerance increase?

No more animal testing?

More and more research indicates the intelligence and feelings of animals. Genetic profiling reveals how closely the genes of even humble species such as mice resemble those of humans. There are moves and discussions afoot to grant animals sentient being status. R&D - already the target for protests about animal use in some countries - might need to be conducted in completely new ways. With the growing capabilities of biological modelling the need for animal testing may reduce. We might also see more testing on humans e.g. on terminally patients willing to take the risk, which then takes place earlier in the development process. More citizen science where individuals use themselves as guinea pigs may bring new opportunities.[71]

Where will the boundaries of personal choice and risk, the need for valid research but the desire for solutions lie?

Personalised medicines, and improved cell growth techniques, real-time monitoring and genetic profiling of predisposition may fundamentally change the nature of drug development and testing and even the need for animal testing. What new regulatory frameworks will be needed?

Personalised medicine on demand?

Drug wastage costs health services millions if not billions of dollars per year. In England a recent report put the cost of total drug wastage at £300 million in 2009: £90 million of unused prescription drugs in people's homes, £110 million returned to community pharmacies, and £50million disposed of unused by care homes[72]. This represents 0.3% of total NHS outlays. Similar levels of waste are almost certain to be found elsewhere. What if drugs were made 'on demand' at an appropriate level of dosage?

3D printing is revolutionising the scale and cost structures of manufacturing and beginning to revolutionise medical treatments. What if 3D production were applied to drug manufacture? In 20 years time could we see a process whereby drugs were produced locally, close to where they were being prescribed, and on demand?

Skill shortages and robo-lleagues (robot+ colleagues)

Robots are moving into professional and commercial arenas. Soon they will be in the home. Robots are being introduced to kitchens, pharmacies, space missions, offices, reception areas, war zones and other high risk arenas such as bomb disposal, roads as auto drive cars. Their abilities to move, interpret their surroundings, navigate complex situations, understand humans, and communicate are expanding. Some have even managed to teach themselves to do certain tasks such as fly[73].

Korea has already developed an ethics charter[74] around the use of robots to protect humans – and robots. Will the development of sophisticated systems and robots which come in all shapes and sizes reduce the skills gap by replacing humans, even in skilled jobs? One forecast suggests that robots could replace 50 million US jobs by the 2040s[75]. Work is known to be a critical factor in health and wellbeing. How would the wider issues and balances of economic cost, competitiveness and skill shortages, be balanced with the detrimental impacts of joblessness or under-employment for millions?

Where will the public interest and therefore the focus of regulation lie?

Ultimate consumer choice and control?

We are moving from being patients to being consumers of health and other forms of care and public service. As consumers in other sectors and markets, we have grown accustomed to making decisions about what, where, when, how we do things, buy etc. Previously nationalised providers in many sectors have been privatised – for example phone, energy, airlines. Choice has become a mantra in many health and other public services.

The sheer numbers of boomers, their growing needs and the concentration of care costs at end of life are focusing minds. Chronic conditions and illnesses are part of a slow and inevitable decline. Health care continues to try to 'cure' problems, often with radical and aggressive interventions. But there is also growing recognition of the need to put quality into life, and that adding years to lifespan is not necessarily doing so, that different approaches to intervention are perhaps needed.

The boomer generation meanwhile is less willing to tolerate the 'inconvenience' of ageing, finding ever more ways to appear, to feel and be younger and fitter for longer. They have a tendency to want to stay in control. The demand for greater choice over end of life care, living wills and assisted dying is likely to increase.

How could a sensible, non-sensationalist public debate and new regulations deliver the necessary checks and balances to protect the vulnerable while also enabling a growing expectation of choice and control, even of timing and nature of death?

Some key points in summary

- The speed, complexity and range of changes affecting public interest, health care and regulation require radically new approaches.
- Simplification, reduction and a one in one out policy on new regulation will be expected and needed, so that all stakeholders can act effectively within the system. Without this approach, an avalanche of regulation to try to control complex situations is likely to result. So too is an ocean of litigation.
- Simpler 'rules' such as 'do no harm' combined with always on, smart technology to provide verification and spot checks of compliance and status may become the norm. Apps may also be part of this process.
- Transparency and trust among and between all stakeholders will be essential to achieve the frameworks needed to foster radical innovation.
- A collaborative, open, bottom up approach - not centralised, command and control will be essential to engaging stakeholders in the changes necessary to health, care and the regulation of care. The kinds of choices and trade-offs

which may be necessary, as well as the ethical debates likely to arise from new technologies will demand new approaches.

- An interdisciplinary cross government approach which takes a long term view of change and integrates issues and uncertainties from different areas of government will be essential – to avoid surprises and costly mistakes and reduce unforeseen consequences.
- The range and speed of technological change will mean that regulators are constantly playing catch up. For example, many hundreds if not thousands of products containing nanotech applications are on the market with almost no regulatory framework. In the UK milk from cloned cows was entering the market before the government had an effective policy. Simpler guidelines e.g. do no harm, rather than regulating for every situation, backed up by monitoring and automation, are likely to be more effective.
- New models of care and an increasingly global market with a range of different styles of provision and cost models will make regulation more difficult while also requiring internationally coordinated approaches.
- As health care becomes both more personal and more preventative, regulation will be even more difficult. Clarity about the locus, boundaries and nature of responsibility will need to be explicit. Transparency will be essential to avoid massive complexity and litigation, and to clarify ownership and 'value' of personal data.
- System security to protect data but also ensure power supply and communications (e.g. for remote monitoring) will create a complex system of responsibilities. These wider boundaries will need clarification.
- A more global market place will require international collaboration on regulation, standards locus of responsibility and transparency.

Geographies affected

Global trends and pressures will continue to exert enormous pressure on national decisions the world over. Canada's close involvement with the American market is a strength and a weakness in this regard and will add a further layer of complexity to the discussions.

Market/ policy response

The growing complexity of the context in which definitions of public interest develop and the expanding range of external changes, which will affect and define it, will not only change the actual nature of public interest. It will also require new approaches to discussing, assessing and defining the public interest and the nature of regulation.

- Government departments and regulatory bodies will need to take a much more holistic and cross departmental, interdisciplinary approach to both assessing public interest and developing regulation.

- No organisation or regulatory system can identify and plan for the full range of changes, issues and events – especially unforeseen events or, as in the recent case of Japan, combinations of events – which can arise. Just as resilience and contingency planning in the case of disaster is needed at individual, community, organisational and national levels throughout the system, so too the boundaries and locus of responsibility for ongoing public interest and 'regulation' will need to operate and be explicit at different levels of the system. It cannot all reside in the organisational or governmental level. Greater explicitness about shared roles and responsibilities will be needed.

- A more explicit and shared approach to defining public interest may also result in greater blurring of boundaries between public, private and voluntary sectors, between personal decisions and public consequences. Open innovation in corporate innovation, and increasingly also in science, has demonstrated that 'outsiders' can often provide the insight to find solutions. Those principles will need to be applied increasingly to regulation and public interest. Political traditions, dogma and definitions may be seriously challenged in the process, as will the traditional stances of various stakeholders.

- Bottom up not just top down approaches will be necessary. Finding new ways to engage with and capture the knowledge, energy, drive and interest of citizens will be important. Collaboration not command and control will be central to engaging with citizens, but it will need trust, openness and transparency on both sides. Crowdsourcing ideas, mobilising resources, mapping the progress of disease outbreaks using mobile phones and apps, and citizen science are simply the start.

- Public debate and greater understanding of science, new technologies and approaches, the risks and benefits will need careful and open discussion. Balanced discussions in mainstream media can often provide a distorted credibility to minority views, by providing equal airtime in debates which then bestows relatively greater credence and representation. For example, in the

'climategate' discussions – the relatively small numbers of naysayers in the climate debate gained equal time in public debates, and increased support as a result. On the other hand, social networking and new media can serve to entrench and reinforce existing opinions, rather than challenge them. As media outlets continue to fragment, and new media take ever larger shares of the whole, so approaches to public debate will need to change.

- Flexibility and responsiveness are essential elements to corporate strategy and survival and will be critical to and expected of those pursuing the public interest and developing regulation in the face of increasing uncertainty, complexity and turbulence. Early warning systems and looking ahead to identify and assess potential changes will become ever more critical to success. Horizon scanning, scenario development, road-mapping, back-casting and action and contingency planning are essential tools. Technologies and data driven analysis will also have a greater role to play.

- Proactively running discussions of the role and potential of new technologies and the wider opportunities and risks they present will be ever more critical to the development of new technology based solutions and approaches. Korea has developed a robot ethics charter as part of its stated aim in becoming a leader in robotics over the next 10 years. As new technologies become ever more closely linked into our personal worlds and lives, so the ramifications need to be considered in new ways. It is no longer enough to have just 'experts' discussing and advising on these issues based on scientific analysis. Public perceptions and debates function in other ways. New technologies will enable new approaches to discussion of their potential and the challenges they address. Public education about risk and science will need to be part of that process.

- Canada as a relatively small nation with a tradition of international engagement could take the lead on developing a more coherent international view of public interest, regulation and health care.

Forecasts

2015	The pressure for greater integration and inter-departmental collaboration on regulation will be forcing new ways of developing regulation within governments.
2020	A holistic inter-departmental approach to developing regulation will become the norm.

2025	Similar approaches will emerge in the international arena.
2030	Global collaboration on public interest and regulation will be widespread.
2015	The general political shift to the right and the ongoing pressures for economic growth will begin to reduce the cost of developing regulation.
2020	Lean government and new ways of working will result in lower costs, greater efficiencies and effectiveness.
2025	Smart thinking will further streamline the regulatory process.
2030	Intelligent thinking, using technology and embedded intelligence to best effect, will radically change how regulation is developed.
2015	The use of social media will become accepted by government departments at all levels.
2020	Social media will be one tool of the emerging collaborative landscape.
2025	Sophisticated systems will begin to make transparency, trust and collaboration the norm.
2030	Intelligent social media will analyse, alert and manage responses and dialogue between stakeholders.
2015	The interactions between different decisions will become more obvious.
2020	More explicit roles and responsibilities in public interest issues will begin to emerge.
2025	New tools for sharing, analysing and displaying information will make the cumulative effects of individual decisions visible.
2030	Stakeholders will examine actions in the light of public interest implications.
2015	All stakeholders will have begun to recognise that the level of complexity and the number of issues affecting regulation will require new approaches and innovation.
2020	A more systemic and strategic, rather than a case by case approach to regulation and protecting the public interest will begin to emerge.
2025	Proactive strategic foresight will underpin cross government, inter-departmental thinking and regulation.

2030	Systems thinking will be the norm within government and between different stakeholders.
2015	Commercial services such as m-payment and location based services have developed new tools to protect identity and personal data.
2020	Willingness and success in developing transparency in commercial services is transferring to public sector services and regulation.
2025	The benefits of personalisation are demonstrating the power of transparency.
2030	Transparency and trust have replaced privacy and secrecy.
2015	Open innovation tools and techniques will be widely adopted; citizens will suggest regulations that should go/ innovations.
2020	Definitions of where 'health care' ends and other services begin, begins to blur.
2025	Stakeholders' actions and collaborative approaches will begin to blur boundaries between public, private and voluntary sectors.
2030	Preventative models and personalised care are the national and international norm.
2015	Health tourism grows; tighter controls about who can access Canadian health care, but also how much 'corrective' care is permissible to rectify overseas mistakes.
2020	Competition between health services grows; overseas insurance based services growing. New risk/ cost frameworks developed.
2025	Health tourism commonplace - global market.
2030	Global competition for patients via health tourism augmented by and in some instances replaced by international telemed / care services..
2015	Emerging shift to personalised services brings new health models.
2020	Nationally based remote health services emerging, smaller hospitals and home based care.
2025	Virtual treatments more widespread; beginning to move to international provision, on shared provision basis.

2030	No new large hospitals commissioned.
2015	New providers introduce and establish personalised health/ care models.
2020	Person centric models increasingly popular; intelligent systems provide reassurance.
2025	Person centred approach becomes proven and demonstrated as cost effective as a result of budgetary/ accounting changes to track costs and investments cumulatively, in new ways.
2030	Few national services, controls and services designed and delivered locally, personally.

Who/ What to watch

- Emerging economies where the combination of constraints, opportunities and investment create radically new approaches and models of management such as frugal innovation. The apparently greater willingness to 'break the rules' and take risks, which western legacy institutions and technologies deter, is creating new rules.
- Social networking and its role in enabling challenges to existing structures and approaches.
- The development of health related apps and the integration of specific personal data.
- Metrics aggregated from the use of social networking and the web. At present these are relatively basic such as the 'WeFeelFine' web site, but marketing and research companies are developing new analytics to fine-tune messages.
- Open innovation in corporate contexts and open science in scientific research. Proponents of new approaches to innovation such as leading business schools.
- Governments such as France and UK which are exploring new metrics of performance such as NNP to enhance the conventional measures of GDP.
- Leading proponents of CSR among large companies as well as new forms of philanthropy and giving to encourage effective use of resources such as ex Silicon Valley entrepreneurs and organisations such as New Philanthropy Capital.

- Protest groups and single issue groups across the world to see where 'the public mood' is moving, and what new issues and concerns are emerging.
- New technologies which have the potential to create disruptive innovation in how we approach the major challenges facing us.
- Korea's approach to policies around robots as an integral part of their vision to have a robot in every home by 2020.

Early indicators

- In 2010 the UK government were caught out by the arrival of cloned meat. A bull had been slaughtered and had entered the food chain in 2009, but when a second one was slaughtered, a ban prevented it from entering the food chain. Meanwhile the bulls had sired 100 cows and all had animal passports to allow them into the food chain. Since then, fierce debate and rapid discussion have resulted in a decision to allow cloned meat into the UK market and the UK government opposing the proposed EU ban. Making policy and discussing ethics of controversial and complex issues at speed is not ideal. Identifying issues and thinking through both concerns and opportunities needs to be done in advance.
- Disaster and contingency planning often focuses on single events within a circumscribed area. The levels of connectivity and transparency in the global economy today mean that wider issues and context need to be considered. The contagious effects of uprisings in one country in the Middle East are one such example of how governments were taken completely by surprise. The co-occurrence of disasters such as the tragic events in Japan another.
- 2008 gave us a foretaste of what food shortages and sudden price hikes could do. WE are entering an era where resources of all kinds from oil and water, to corn and rice, to rare earths and metals could be in short supply. Eminent scientists, such as Professor Beddington in the UK, are already talking about the threat of a 'perfect storm' of climate change impacts on yields[76], food, water and other resource shortages. Shaping Tomorrow forecast this in 2005 showing that while we cannot predict the future we can create effective scenarios and models based on sound judgement and continuous future watching.

Drivers & inhibitors

- The political landscape is the biggest driver of direction of change overall, but also the greatest uncertainty over the next 20 years. As a key uncertainty it provides a basis for scenario planning/ morphological analysis to assess other drivers and options.
- The biggest challenge and therefore the greatest potential inhibitor to developing effective new regulatory frameworks for this complex and challenging environment is government's inability to adapt and respond fast enough.
- Government's inability to respond could itself become a driver for change. The problem will be that it is reactive to crises rather than pro-active through strategic foresight.
- Failures to inspire, engage with, and enable key stakeholders to anticipate and prepare for change. A key driver, as indicated above, is to take the current crisis – and future ones - as an opportunity for change.

Parallels & precedents

The post war era

The emergence of new systems and approaches in the wake of the Second World War, when visionaries established many of today's systems and services to serve to build a better world.

The fall of the Berlin Wall

The fall of the Berlin Wall and the current uprisings and protests in the Middle East and North Africa where bottom up determination and energy have provided a radical force for change.

The emergence of a democratic South Africa

The emergence of a democratic South Africa after the release of Nelson Mandela, which relied on the Truth and Reconciliation processes, but also the Montfleur scenarios process which engaged with people from across the political spectrum to identify and recognise the implications of different futures, and what was needed to ensure the preferred future.

Margaret Thatcher once said: '*that which defies the human spirit will eventually fail*'. Asking where the human spirit is being defied such as Tunisia, Libya, Egypt, Bahrain, Yemen, is already breaking free, provides an indicator of future hard to see change.

Spin offs

- A new 'peacekeeping' role for Canada as a forward looking 'neutral' focus for debate about the ramifications of the changing nature of public interest and the boundaries between personal, local, national and international priorities.
- Public interest could become an organising principle for debates on any number of topics and a part of education.
- Smarter, leaner faster government.

Disruptions/ Trigger events

Austerity budgets and the need radically to reduce government spending and national debts have become part of mainstream political debate, in and of themselves. A range of external events could radically increase the pressures on those budgets, forcing far greater cuts and changes to systems such as universal health care that have been part of the national way of life.

What if China stopped driving growth?

The global economy has survived a major recession, courtesy of growth in China and other emerging economies. China's growth may wobble in the foreseeable future – there have been concerns about overheating, although those seem to be receding, and looking to the future, China's population is set to age quite sharply: by 2030 it will have 380 million people over 60. There are already discussions about loosening the one child policy in order to reduce skill shortages.[77] China's role in cyber-attacks, resource constraints and world politics are all potential risk factors.

Resource conflicts on Canada's doorstep?

Canada has been isolated from direct conflict and attack for hundreds of years. The race for the arctic could change that. Access to new resource supplies will undoubtedly provide huge opportunities, however the lack of clarity and agreement about boundaries, exclusion zones and rights to those resources among the nations bordering the arctic could cause ongoing problems; even conflicts.

Elsewhere in the world conflicts over resources are likely to grow with food and water shortages or shared resources such as rivers which cross international boundaries, potentially at the heart of many such conflicts.

Disasters do happen

Single events, such as the ice storms that crippled power supplies, are difficult enough to manage and respond to. The co-occurrence of a major weather event and

cyber attacks or pandemic could put public systems and services under intolerable pressures. Contingency planning and new approaches to resilience are needed to address the range of unforeseen 'things waiting to happen' and to protect and promote public interest.

But disruptions can also be positive.

Energy breakthroughs

Abundant, cheap always on energy supplies would radically change the world economy and the potential for development, and therefore markets, in emerging economies. Solar energy could be one such source and levels of investment are growing and new technology capacities arriving regularly.

Seriously disruptive technologies combining

The coming together of radically different but equally powerful new technologies will create opportunities for revolutions. Technologies such as cheap genetic profiling, followed at some stage by proteomic profiling, neuroscience based interfaces and approaches for enhancing physical and mental capability, embedded intelligence and real-time remote monitoring and data analysis, nanotechnology based processes, products and materials applied to a vast array of new applications will all revolutionise how we do things. Health in its widest definition - care, cure, lifestyle, promotion and prevention – will be a major beneficiary. But it will not happen without careful debate and reassurance, good design and effective testing.

Integrating personal data into a generic app

Phone apps have already transformed how we organise our lives, find information and use phones and tablet computers. At present, health related apps are generic; once they have the capacity to incorporate and build on specific personal data – starting probably with health records, but then even genetic information, a revolution is likely to take place.

Next steps

This brief provides only a preliminary scan of the current environment, out of which a multitude of questions arise that need watching as the future unfolds.

We recommend:

A focus on improving agility

- Develop regulatory framework fit for the 21st century
- Evaluate and close gaps

- Considerably simplify regulation
- Develop cross-departmental approaches
- Establish international network of reforming regulators
- Establish best practice regulatory change monitoring system
- Establish global crisis monitoring for lessons learned
- Establish a public/business suggestions system for reducing unnecessary regulation

Then re-visit again and again

A focus on improving resilience

- A driving/restraining force analysis focusing on regulation would uncover which forces could build stability or instability; thereby highlighting the most significant systemic emerging threats and opportunities.
- The development of early warning systems, for example – continuous horizon scanning, trend and surprise analysis, scenario planning, stakeholder surveys, road-mapping, back-casting shared by all government departments.
- Creation of a regulations roadmap covering the next 15 years. Projections and forecasts need to consider the rate of changes to the fundamental pace of change in regulations which could be depicted on a time line with a weighting of the forces causing the transformation.
- Likewise, 'What If' scenarios that compare differences in reactions to events and changes could expose significant implications resulting from certain strategic positions and timing.
- And, from these a back-cast of what needs to be done now to stay ahead of the game.
- Mapping and characterizing the complexity of the interdependent change agents would highlight the most imminent transformative events and patterns and develop a potential robust surprise analysis.
- A study of parallel case studies could develop further insight from past experiences and strategic models.

- Stakeholder surveys on regulations affecting consumer behaviour, demographic shifts, and economic long-term cycles to build a view of the full multi-dimensional picture.

These analyses would provide a systematic forecasting tool to evaluate future changes to regulatory processes and anticipate and better prepare Health Canada for future issues.

Methods used

Horizon scanning using Shaping Tomorrow's own resources

Shaping Tomorrow collates some 350 indicators of change every week through its website and contributors worldwide: current total about 61,000 on topics across the full PESTLE framework. From these our team identifies a range of trends – both new ones and additions to existing areas of change. As part of this process, we publish an extended trend alert on a specific area of change each week. Current total of trends - over 3500.

The research team conducted searches of both the Scan and Plan sections of the website to identify patterns and critical changes in the external environment which might affect public interest and regulation as it might apply to health in the future.

Trend analysis

Using our own tools and professional judgement we then reviewed the potential trends and selected those we felt would have the greatest impact on the long term direction of public interest and regulation with a particular focus on health, within a wider context.

Wider internet search for published materials

During the development of the brief we then searched other sources and reports for additional materials to illustrate the areas of change as well as responses to them.

Legal Disclaimer

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