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Science and technology foresight: a provocative tool for contending with future challenges in food safety and public veterinary medicine

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Summary

The author describes how foresight methods can provide a provocative approach to some of the key challenges faced by the world of animal health and public veterinary practices while supporting the safety and security of the food system and public health in general. Being provocative is important because the future may be very unfamiliar and demands an approach of critical thinking, which can best be activated by having to consider the prospective reality of one or more substantially different policy operational environments. The factors that are shaping our future may also be quite disruptive (for example from 1989 to 1994 when the Cold War abruptly ended, the Soviet Union dissolved and the internet was born). Consequently it is essential that any forward preparedness efforts explore a range of plausible options and not immediately discount those that may in today's terms appear unlikely. The author reviews the methods through to the point where scenario parameters are defined, and then switches to observations about how the process can influence and provoke policy formulation. The results of the foresight and scenarios employment are described by Willis in another paper in this volume.

Keywords

Animal disposal, Animal futures, Animal health, Crisis management, Foresight, Pandemics, Preparedness, Public health, Science, Scenarios, Stamping out, Strategic planning, Technology foresight.

Scienza e tecnologia previsionistica: uno strumento innovativo per far fronte alle sfide future nel campo della sicurezza alimentare e della medicina pubblica veterinaria

Riassunto

L'autore descrive come i metodi previsionistici possano fornire un approccio innovativo per far fronte ad alcune delle sfide chiave affrontate in sanità animale e medicina pubblica veterinaria supportando contemporaneamente la salubrità e la sicurezza del sistema di produzione degli alimenti e della sanità pubblica in generale. L'innovatività è un requisito importante poiché tale scienza deve prevedere il futuro che può essere sconosciuto e richiedere un approccio di pensiero critico, che può venire innescato più efficacemente considerando le probabili realtà di uno o più ambienti operativi politici sostanzialmente differenti. I fattori che disegnano il nostro futuro possono anche avere effetti dirompenti (per esempio quando dal 1989 al 1994 si assitette alla fine improvvisa della guerra fredda, alla dissoluzione dell'Unione Sovietica e alla nascita di internet). Conseguentemente è essenziale che ogni sforzo atto a preparsi per eventi futuri esplori un range di opzioni plausibili e non scarti immediatemente quelle che al momento dell'analisi

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appaiono improbabili. L'autore passa in rassegna i metodi esaminando direttamente il punto dove i parametri dello scenario sono definiti, e quindi osserva come il processo può influenzare e creare diverse linee politiche. I risultati della previsione e gli scenari di impiego sono descritti da Willis in un altro lavoro in questo volume.

Parole chiave

Distruzione animale, Gestione crisi, Il futuro degli animali, Pandemia, Pianificazione strategica, Preparazione, Previsione, Salute animale, Sanità pubblica, Scenari, Scienza, *Stamping out*, Tecnologia previsionistica.

Introduction

Strategic readiness for difficult situations involving public authorities can have both short-term and long-term implications. When ensuring the safety and security of its citizens by managing responses to received threats and challenging events, governments are also held responsible for looking ahead to avoid real dangers that may not be readily apparent in the intermediate turmoil of near-term crisis response and mitigative actions. Just as importantly, in the interests of long-term preparedness, they must nurture both protective and adaptive capacities by developing the necessary thinking to anticipate change and unexpected events. While negotiating external and internal forces and taking a forward-looking view to meet future challenges, governments are better prepared if they can reduce uncertainty and increase strategic options available to them and their citizens.

Since opportunities are not often apparent when staff members are entrenched in the daily administration of specific duties and long-standing paradigms, national governments require the dynamism of diverse and strategic stakeholder groups in focusing on foresight initiatives in an interactive real-time manner.

Government foresight operates predominantly at the national level and is designed to increase strategic preparedness. It often focuses on identifying possible directions for technology and science programmes by providing the decision-making process with research, development and communication strategies that will benefit future policy. Foresight, in approaching uncertainty from the outside-in, attempts to broaden the perception of an organisation and to challenge assumptions through more external and objective analysis towards a deeper level of learning and understanding of complex systems than that normally prevalent in the policy environment which can often succumb to inside-out thinking. By focusing on uncertainties, analysing trends and exploring driving forces and risks from a future perspective, the steps that should be taken in the immediate future to ensure greater flexibility, knowledge and scope for action can be identified. Making better strategic decisions and more agile yet anticipatory plans in a rapidly changing world is the goal, rather than to predict the future.

In this context, influencing present day actions and decisions, including funding and setting priorities on vision building, is a key objective in a world that is changing so fast that it has made the rational planning approaches that many organisations use ineffective, because they are based on the tenets of relative stability over a relatively long period of time.

Foresight is neither a plan nor a forecast because each implies a clear preference to the exclusion of other options that may be plausible. Foresight is also not the same as a policy or a prediction for the same reason. Instead, foresight is designed to ensure preparedness for diverse contingencies. The goal of foresight and contingency planning is to develop a range of prospective, plausible or possible futures that an individual or organisation may have to contend with, employing both analysis and imagination in a systematic way. The overarching aim is to build a better quality of life by being prepared to see the opportunities for meaningful innovation (Fig. 1).

World of change and surprise

In a world that is full of surprises, it is increasingly important to incorporate

contingency planning and to rehearse preparedness capacities, while at the same time breaking down the boundaries that limit the perceptions of key actors. It is easy to become stuck in a present reality that seems rather stable and comfortable, while change happens 'somewhere else'. Technological innovation is accelerating at a rapid pace on a global basis and it continues to play a fundamental role in shaping international foreign policy and global trade, along with competitive practices.

Figure 1
How foresight tools can assist in long-term planning horizons
Used to brief clients
Source: Office of the National Science Advisor

Over the past twenty-five years, the challenges of the HIV/AIDS epidemic, the end of apartheid in South Africa, an increase in terrorism, the explosive growth of the internet, the human genome project and the end of the Cold War all took place; most policy observers were unable to anticipate such events. Some foresight practitioners, however, had already considered what action to take if confronted by similar situations. As early as 1985-1988, the Shell Group Planning scenario specialists were examining factors that were portending the Cold War conclusion and the onset of a new cycle of surprises connected with global climate change and ecological sustainability. Peter Schwartz provides a more recent similar view of foresight-able circumstances in *Inevitable surprises* (4).

The animal health challenge for Canada

Recently, the economic fallout from severe acute respiratory syndrome (SARS) for Canada was unexpected and costly. This was a real alert call for Canada, as some estimates of lost time, cancelled tourism and extra security costs incurred in Toronto and throughout Canada as result of SARS reached as much as US$1 billion (1). Globally, since the discovery of avian influenza in Asia in 2003, the world public health authorities have been on a pandemic alert, with substantial new resources being made available by most governments to increase preparedness and augment monitoring and vaccine supplies.

Lingering in the background remains the strategy of 'stamping out' where both responsible as well as frightened governments, or at least their public health authorities, seek to ensure that they are not complacent in the face of major health threats. 'Stamping out' refers to the practice of public authorities engaging in mass destruction and disposal of animals exposed or potentially exposed to diseases, especially zoonotic diseases that can leap from animals to humans.

This is the context in which the Office of Science and Technology (S&T) Foresight first became involved in a foresight project for animal health in the autumn of 2004. At that time, there had already been some preliminary meetings between four key countries, Australia, Canada, New Zealand and the United States, known as the 'Quadrilateral Group', where animal exports represent high profile elements in the total export economy. These countries concluded that they needed to not only work more closely together but also to investigate how they might reduce their vulnerability and capacity for rapid, safe and eco-friendly responses to the next crisis. Consequently, in early 2005, a strategic group of Canadian and United States animal health and public health officials, educators and practitioners was convened at Michigan State

University in East Lansing, Michigan, to develop a scoping framework for animal health foresight (3).

The previous decade had witnessed several high profile incidents where animal health issues caused local and national populations to be concerned – most notably in the United Kingdom where foot and mouth disease and bovine spongiform encephalopathy (BSE) or 'mad cow disease' were perceived as endangering the food system and posing a threat to the human population.

Foresight attempts to place the focus on the real drivers of a problem and to identify the areas of greatest impact and uncertainty, because that is where both the surprises and most of the solutions will probably come from. The way that foresight provokes thinking in terms of preparedness or approaches to this type of difficult situation is first to distinguish what factors are in fact driving the situation and which are the principal trends that every nation or player may have to contend with but equally be unable to alter. It then examines a range of prospective wildcards or shocks that could stress the system.

The United Kingdom Joint Doctrine and Concepts Centre of the Defence Ministry is a leading proponent of differentiating drivers from trends and shocks. Figure 2 illustrates how foresight is applied by that Centre to the scoping of a threatened environment.

In Table I, the bold entries indicate how animal health concerns represent an important factor within a larger list of the macro trends derived from S&T in part or in their entirety, and the resulting major uncertainties.

Situating the present and its vulnerabilities is a critical first step when approaching foresight. This step commences at the macro level as indicated in Table I.

Most foresight processes then follow a three-pronged approach. The first approach relies upon developing some consensus or alignment around the most critical drivers/uncertainties. A diverging set of scenarios is designed to capture the effects of trends, drivers and shocks in multiple boundary conditions for prospective policy challenges. Secondly, participants are asked to develop and address a series of 'challenge questions' that provide a clear focus on the specific issues that need to be addressed.

Figure 2
Differentiating drivers from trends and shocks – applying foresight to the scoping of a threatened environment
Source: United Kingdom Ministry of Defence Development Concepts and Doctrine Centre (5)

Finally, participants are then required to back-cast, from the future time of the scenarios to the present time, to derive policy recommendations and inflection points where strategic decisions, in terms of the issues and challenge questions, could have enabled or altered policy directions and outcomes.

Figure 3 outlines foresight steps that are taken to elaborate the detailed application of foresight methodology to broad policy issues.

The animal health group started the foresight process by outlining the situation it was facing in terms of several key issues or critical problem areas that it felt the foresight process should address or at least take into account. An interesting point is that most of these issues are also persistent challenges that link the past, present and future. When grouped into

Table I
Macro foresight trends and uncertainties

Macro shaping trends	Major uncertainties surround
Integration, miniaturisation of technology	Individualism versus community
Globalisation of trade, capital, terror	Sustainable development dynamics
Harmonisation of standards, protocols	Access and use of weapons of mass destruction, including bioterrorism
Migration, multi-culturalism of populations	Outward-looking communities versus isolationism
Intensification and differentiation of wealth	Financial market consistency and performance
Bi-polarisation of religious values and secular evolution	New diseases, viral spread, containment
Transformation of infrastructure systems	Consequences of global warming
Virtualisation, digitisation and integration of business models, communications, entertainment, education	Impact of changing fertility rates
Automation and customisation of production	Food system sustainability – dependence upon animal protein
Acceleration of knowledge services as an economic driver	
Proliferation, adaptation, rapid circulation of disease	

common or interdependent areas, they become the key lenses through which the complexity of this environment can be better understood and managed.

They also signify the lead into the 'drivers and challenges questions' that will follow. The group discussion begins to provide a context for the selection of drivers that will eventually shape the scenarios, which are selected to prompt more focused exchanges about the range of futures with which the group should be prepared to contend (Table II).

Following this step, the drivers of change and the challenge to the group regarding the drivers that carry the greatest uncertainties and impacts, are examined. As foresight is ideally an outside-looking-in process in which an atmosphere of preparedness is created for the world that may be coming rather than the one we may prefer, it is important to start at the level of global change drivers. Table III provides a summary of several factors that cause global tension and societal uncertainty.

The initial list of drivers that were identified by the East Lansing Group is given in Table IV.

S&T foresight relies on correctly interpreting S&T change drivers and the causal and temporal factors involved with change when future social, economic and political realities are involved. Therefore, it is not only highly analytical but also speculative exercise that incorporates imagination and creativity.

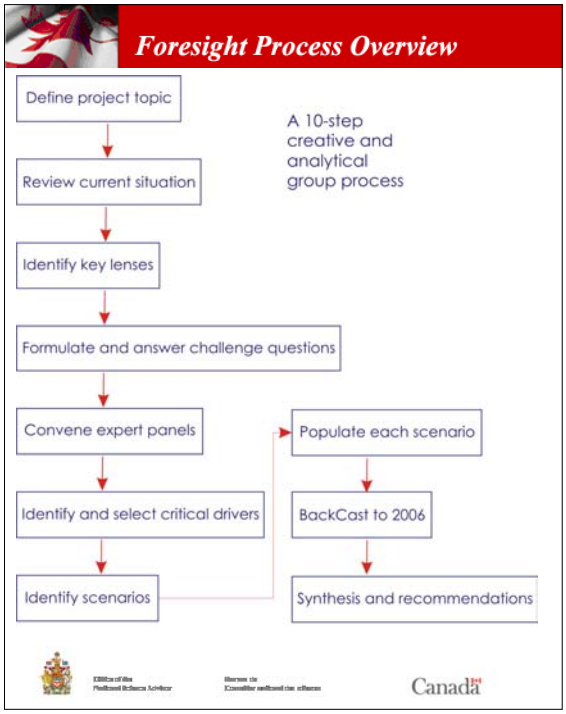


Figure 3
Foresight steps taken to elaborate the application of foresight methodology to broad policy issues

Table II
Broad socio-economic issues and change perspectives (contributed by expert panel to prompt focused exchanges on the selection of critical drivers)

Scoping issues
▪ Many emerging diseases are zoonotic
▪ Historic precedents exist of some success, 'the way we've done it in the past and it works – to a degree'
▪ Stamping out is socially and economically unacceptable; seen as a crude, blunt instrument
▪ Health and emotional toll on farmers
▪ Public perception that the crisis is out of control; experts are 'lost'
▪ Inadequate communications from politicians to public; politicians reporting from out-of-date science
▪ Some alternatives are unacceptable in some cultures
▪ Economic cost, market and global trade losses
▪ Poor risk accounting to the public; the public expects zero risk
▪ Media portrayal of issue
▪ Clashes of opinion on issue amongst media, public, government, agriculture
▪ Inability of the sector to do appropriate, differentiated crisis management
▪ Logistics are unmanageable – size, scope, transportation; sector capacities for management are exhausted
▪ Negative environmental impact
▪ Limited expertise worldwide to deal with emerging problems
▪ Non-compliance and non-reporting by municipalities, producers, owners, animal rights advocates
▪ Animal rights, environmental impact challenges, legal issues
▪ Agricultural evolution, transition to large-scale operations means an increase in the size and scope of the problem
▪ Jurisdictional conflicts
▪ Visibility of the issue leads to vulnerability to terrorist threats
▪ Creation of winners and losers
▪ Eradication implies failure of prevention

Table III
Societal change drivers

Driver categories
▪ Demographics – population changes
▪ Science and technology – knowledge and innovations
▪ Environment – carrying capacity, global ecology
▪ Attitudes, values, beliefs – from opinion to religion
▪ Global economy – interdependent markets, trade
▪ Governance and institutions – political organisation
▪ Evident threats – to civilisation and infrastructure

How science and technology foresight works

S&T foresight provides planners and decision-makers with a process and a product to help identify potential links between current policies and actions and future outcomes. Its value lies in pushing the boundaries to capture broadly based thinking on a long-range time horizon. It can help policy makers and planners identify possible threats and opportunities at an earlier stage, by illustrating how barely recognisable trends and drivers, or 'weak signals', can have important consequences in the future.

For example, during the 1960s, the first discoveries of laser light and atomic scale measurement became available as computers and new scientific instrumentation developed.

Table IV
Initial list of drivers identified by the East Lansing Group

Critical change drivers for animal health
▪ Availability of new technologies, e.g. rapid diagnostics, breakthroughs in medicine, increased understanding of disease
▪ Too expensive to continue on the present course
▪ Link between human and animal health
▪ Growing resistance of animal producers who believe their prosperity and quality of life are being destroyed; it is becoming a political pressure
▪ Environmental problem of waste
▪ Societal pressure – reaction to killing, spending of public funds, disruption to tourism, etc. – leads to political pressure
▪ Marginalisation of veterinary decision-makers
▪ Agency capacity is at the point of exhaustion
▪ Logistics become more complicated as farms get larger
▪ Loss of confidence by investors, public, government and in experts and policy makers
▪ Waste of protein in light of global human hunger problem
▪ Industry wants to 'keep meat on the menu'
▪ Public demand for zero risk
▪ Absence of coordination of information technology
▪ Increased hypersensitivity of media to the problems
▪ Absence of a coordinated global response
▪ Recognition of macro-economic impact of the industry
▪ Threat of bioterrorism
▪ Need for coordinated, differentiated approaches

Soon the new fields of photonics and nanotechnology began to emerge as prospective foci for S&T. By the 1980s, applications of lasers were having an impact on medicine, electronics and manufacturing and nano-scale engineering devices were being imagined. Another 20 years later, real progress and significant changes for materials, computing, biohealth and science itself are now apparent in business and society from these two early signals in relation to future S&T.

In the context of animal health, there have been several signals that have portended major threats (mainly in third world circumstances) as large and rapid growth populations and impoverished governments have tried to cope with disease spread amidst difficult circumstances. Even in the developed world, regular stamping-out situations occur, such as the cull of 19 million poultry in British Columbia in Canada in the spring of 2003 (2). Adapting these types of threatening signals to scenarios has also created some very contentious situations that highlighted the enormous extent of negative impacts that could at least in theory follow (6). The Proteus scenario posits a future world characterised by a persistent, global, highly contagious disease that changes the way international travel, health, commerce and many other public functions are performed. Clearly nobody wants to have to face a possible threat becoming a reality that would require massive societal isolation.

The challenge for animal health foresight and animal population managers, and organisations with the ability to recognise the link between these 'weak signals' and potential threats or opportunities, is therefore how to be better prepared and ready for rapid response. It is also how to make good research and development choices well in advance, how to develop contingency plans and how to become more agile and effective in decision-making.

Foresight planning focuses on a long-term planning horizon of between five and twenty-five years and aims to explore options and possibilities among a wide range of future scenarios.

Creating challenge questions

A foresight exercise typically targets one issue or problem and examines a number of possible futures, or scenarios, that might arise from it. A multi-disciplinary team of thinkers is assembled to tackle the issue, usually through a series of workshops, panels or conferences. The team, over time and in a structured process, shares current knowledge of emerging research, ideas and trends to first construct a set of 'challenge questions' and then develop multiple, plausible scenarios, describing alternate future states. The team can then look forward and back between the present and future states to identify likely issues and developments that would contribute to each future scenario.

For example, a ten-year forward scenario that anticipates greater ecological damage from unrestricted emissions because of a failure to manage automobile efficiencies and other atmospheric pollutants could pose a question for back-casting: what preparations in the period 2005-2010 would have been necessary to avoid the situation being experienced in the 2015 time period, and what advice would the team wish to give to policy makers to mitigate the most negative impacts of this scenario given its plausibility? A foresight exercise might yield up to ten different scenarios of this nature for the future, some positive or hopeful, some negative or subject to major uncertainties – each dependent on triggers and developments that might plausibly come to pass over the time horizon of the exercise.

In the course of a foresight exercise, other tools may also be employed or incorporated into the scenario planning. These tools can include literature reviews, technology mapping, web surveys, Delphi iterative issue polls and challenge dialogues.

Table V lists the main 'challenge questions' that were developed by the project team following the discussion by the East Lansing Group for the three subsequent meetings held in Calgary, Minneapolis and Ottawa later in 2005.

Scenario parameters

A crucial stage of the foresight process is reducing the list of drivers to those that will be used to frame the scenarios. This is a challenging process in itself as participants must weigh many factors and settle upon those they believe will really make the difference between heading in one direction, which becomes the preferred or normative scenario, and having to cope with three other very different options, all of which may have significant associated problems.

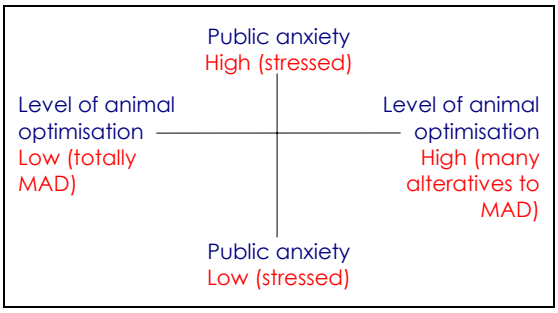
In the case of the animal health group, the choice evolved into a discussion of how important both S&T and public communications would be in the future and what strategies would be necessary to realise the preferred option, even if one might have to experience some of the effects of the other options along the way to success. The story of these strategies and their application to the future of animal health management is discussed by Willis in this volume (7). The scenario parameters are presented in Figure 4.

Conclusion and lessons learned

Foresight should be seen as a useful learning tool for policy researchers, as a forward planning and exploration asset for policy advisors and as a context setter for policy makers. By identifying early alerts and emergent developments, foresight can provide the agility required to enhance the resilience of policy framing, and can expand the range and robustness of policy options.

Table V
Animal health foresight challenge questions

Key lens	Issue dimension
Information management and skills	1. Knowledge sharing and emergency response to animal disease crises in 2020 are both highly effective on a global scale Describe how this is so, from the perspective of all stakeholders (industry, researchers, government) in terms of technology and people skills. 2. What new skills and training priorities for personnel have made the greatest impact since 2005 in the creation and implementation of innovative alternatives to mass animal destruction? 3. In 2020, every animal in the food supply is individually tracked What are the most important attributes of this tracking system and why has it proved to be so beneficial?
Trade and economics	1. How have changes in global livestock production increased or decreased economic incentives for mass animal destruction as a disease control strategy? 2. What changes in international trade agreements or standards have enabled countries to respond to foreign animal disease outbreaks without using mass animal destruction? 3. In 2020, under what conditions do we let nature run its course during a foreign animal disease outbreak?
Policy and regulation	1. What changes in the roles and responsibilities of industry, government, consumers and politicians have been necessary to achieve a cooperative, science-based, effective and fully understood process to establish policy for the management of animal disease? 2. What policy changes have been necessary to create a paradigm of animal health optimisation? 3. What changes have been necessary to allow a wide menu of choices for responding to animal diseases while maximising the benefits for the global public and the economic viability of industry?
Advances in science and communications	1. What advances set the stage for effective disease risk management without mass animal destruction? 2. How have advances in communication tools and strategies reduced public anxiety over animal disease risk management? 3. How have influential leaders from various sectors been engaged in critical issues regarding animal and human health?



MAD mass animal destruction-disposal

Figure 4
Driver axes for scenario development

In a world where innovation has become faster, global in scope and more technologically dependent, the broadly based insights that foresight examines help create agility and preparedness which in turn can be highly effective as inputs to innovation policy.

With these insights in mind and because foresight encourages participants to contend with plausible, contingent scenarios and evaluate their prospective policy implications, it is proposed that foresight become a valued *provocateur* for government and industry managers of complex issues and diverse challenges, such as those posed by animal disease within a highly interconnected and often vulnerable food system.

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