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Complexity and Risk

Key Lessons from Chapter 3: Complexity and Risk

This chapter focuses on concepts about complexity that are useful in any decision setting. This includes identifying the nature and types of interactions surrounding a decision and understanding their implications. It is critical to observe the variations in the pattern of behavior after action in an interconnected system and the ensuing pattern of risks and their severity. This chapter also introduces the role of learning from the past and reacting rapidly to changing situations, as well as the role of values and the behaviors that serve best in choice making under uncertainty.

Specific skills introduced in the chapter are useful for guiding decision-making under increased complexity. These include: (1) the ability to observe and adapt to variations in the operating environment; (2) skills for assessing and selecting from a variety of options with little or partial information; (3) options for functioning in areas with low predictability about the future; (4) approaches for adjusting to the range of actions of other stakeholders; and (5) methods of engaging in actions to shape the global properties of decision environments for a common future outcome.

The dynamics of change may lead to complex outcomes defying the beliefs that people hold concerning the likelihood of ensuing actions. It is human nature to rely on a limited number of heuristic principles that reduce complex decision-making processes or tasks to simpler judgmental operations (Tversky and Kahneman, 1971). When making decisions in the presence of multiple alternatives, decision makers employ search strategies designed to eliminate some of the available choices as quickly as possible (Payne, 1976). The process of elimination to reduce the complexity of choices is done on the basis of limited information—hence introducing judgment by heuristics into the process. As such, the characteristics of the decision process determine the approach to choice making (Payne, 1976). It is important to have a better understanding of complexity so that the final choices made in the face of dynamics of change may be understood with the appropriate

F. Léautier, *Leadership in a Globalized World*

knowledge of what risks might be introduced by the selected method of decision-making.

This chapter expands on the issues of complexity and risks that come from the dynamics discussed earlier. The purpose is to support leadership learning in understanding *"What you need to know about complexity and risk to better navigate your specific context?"* The chapter starts with a few general concepts and outlines the specific skills set that is needed to navigate uncertain and risky scenarios. The analytical skills required are illustrated through examples and tools available to support decision-making in this area. There is also a focus on the behavioral skills desirable to succeed in risky and uncertain environments.

Introduction to complexity and risk

Few general concepts about complexity are useful in any decision setting (Bar-Yam, 2005a). Complexity generally increases with increasing interactions among previously independent systems. A failure or an effect in one system is transferred to other interconnected systems. Higher complexity has the potential to generate a set of new risks and challenges, and has been known to create more frequent risks and added severity of risk, and can even lead to further synchronization of risks. A small initial perturbation can dissipate, propagate, or be enhanced with long-ranging effects. When complexity is high it becomes progressively more difficult to predict the outcomes of a strategy or course of action. New approaches are therefore needed to guide leaders, decision makers, and analysts to select among competing strategies and outcomes.

The specific skills that are useful when operating under risk and increased complexity have to do with adaptability to *variation* in the environment for decision-making. Other skills relate to the degree of comfort in the *selection* of options with little or partial information, and where predictability about the turn of events or the future is low. Leaders need to be aware of the potential range of actions of other agents and the nature of their *interactions* in shaping the global properties of the decisions they are about to make.

Globalization is expected to increase the degree of synchronization of business cycles, enhancing global spillovers of macroeconomic fluctuations, particularly in industrial countries (Kose et al., 2003). Macroeconomic fluctuations of particular import include an investment or consumption boom in one country generating demand for increased imports and hence boosting economies abroad. Fluctuation in trade flows could induce increased specialization of production across countries, resulting in changes in the nature of business cycle correlations. As consumers benefit from global trade and preferences drive manufacturing, aided by smoother logistics, the speed at which changes are transmitted from one country to another and one system to another could increase.

Another example comes from transport. Consider the case of the volcanic eruptions in Iceland in 2010 that resulted in the largest air traffic shutdown since the Second World War. A volcanic eruption of this level previously would have been limited to Iceland and a small section of its airspace. Because of the volume of air travel and the degree of interconnectedness between airlines and countries through travel, the volcanic ash had severe impacts on an extended part of the world. Large parts of European airspace were closed completely for nine days (April 15–23, 2010) and intermittently thereafter until May 17, 2010.

Volcanic ash incidents indicate how a small event in one country can have an impact on a series of decisions in an interconnected system. A challenge and failure from the European airspace system caused delays and closures of other airports around the world, over and above the travelers in the specific aircraft caught in the ash crisis. Passengers who were stranded needed to select from alternate air routes or other modes of transport like rail and road to make it home. Meetings were held by video instead of face to face, and travel plans were canceled or changed. The incident resulted in a speeding up of the integration of European national air traffic systems into a Single European Sky (SES) (see European Commission, 2011).

The crisis of volcanic eruptions and the delays and losses to airlines resulted in a change in attitudes toward an integrated airspace system and resulted in decisions that would be different had the crisis not occurred. European lawmakers had to adapt, reacting to citizen demands and reality on the ground. Delays in travel with stranded passengers required swift decision-making by airline and airport managers to feed, house, and accommodate those caught in this unusual event. Such adaptability was very useful when the Icelandic ash disruptions manifested again in later years. European airspace leaders had learned how to manage such large disruptions. Leaders in the airline and airport business had "practiced" under a previous scenario and were ready for the outcomes of a more serious one.

These two illustrations show that decision-making in one setting is increasingly impacted by choices made in another setting. In the absence of total control, and without past experience in handling a particular scenario, one needs to make the rules as you go along. An example would be the decision to coordinate central bank activities to attenuate the effects of the euro crisis, as happened in 2011 (Hilsenrath and Sparshott, 2011). Other choices are to react rapidly to changing situations, as in the case of volcanic ash blown from Iceland. With limited experience in handling crises and little knowledge of the effect of choices, values are what remain as the true guide. The behaviors that serve best in choice making in the face of complexity and risk need to be learned and practiced and perfected over time.

Adapting to global constraints: the challenge of sustainable development

Many interactions are made more complex because of the desire by society to control some of the outcomes of those interactions. So, for example, while all countries are deeply in search of the means for higher economic growth, choices of strategies across countries and within specific periods of time constrain or enable the range of strategies to be selected from. Sustainable development is a concept that encapsulates such complexity of decision-making in very deliberate ways, by considering issues like irreversibility of ecological change, fundamental uncertainty, and system complexity (Faucheux et al., 2013). One key question about sustainability has to do with the concept of economic growth, which is a critical requirement for raising the welfare of billions around the world.

Countries have been growing at different rates over time, with countries like China managing to attain multiple years of very high growth rates and other countries growing in bursts of high growth followed by slower periods of growth, as in Ghana and Tanzania. At the same time, other countries like France and the Netherlands showed low levels of growth. As countries interact more, they depend on the level of growth attained in their neighbors' or trade partners' economies and this dependency calls for common decision-making on a series of policy choices, rendering economies even more integrated.

The level of interactions is increasing for many reasons, but migration is one of them (Castles and Miller, 2009). Migration patterns across countries are uneven and are driven by different forces. Patterns of migration have implications for how societies and economies integrate and also for how stable such integration may be. More people live in cities in the 2000s and they are more connected. They live in common spaces, but they do not necessarily have commonality of purposes, as individuals with commonality of purpose need not live in the same geographic space, but can find each other across long distances through social media channels like Facebook and Twitter. There is a varied rate of connectivity and globality across cities in the world, with some cities being open to outside ideas and influences while others remain closed, with implications for the evolution of democracy and choice. Taken together, these long-range social influences have an impact on economic behavior and vice versa. Other effects of increased interaction are disease burdens and global medical capacity, managing scarcity of water and food, and the implications of changing weather patterns on the prices of food. Scholars have come to question whether trade and globalization is a good or a bad thing when looked at from the lens of sustainability.

Kellner (2002) articulates a critical theory of globalization that brings out the contradictions brought about by the fundamental transformations in the world economy, politics and culture. He places particular emphasis on

the directionality of globalization from above (through technology and capitalism) and from below (through local reactions and democracy), and the implications of such forces of change on the final outcome of globalization. Choices about sustainability are at multiple levels—global, regional, national, and local—and can benefit from the science of complexity. O'Brien et al. (2004) bring out geographical differentiation in vulnerability to climate change in a methodology applied to India which uses vulnerability mapping, and local-level case studies to assess the varying nature of vulnerability for any particular sector in country or region can be used as a basis for targeted policies and decisions.

Learning and the speed at which ideas spread are also causing fundamental shifts in the behaviors of individuals and economies alike. Arnett (2002) investigates the psychological consequences of globalization, with a particular focus on identity, arguing that globalization results in the development of bicultural identities whereby young people join self-selected cultures to maintain an identity separate from the global culture. Young adults and adolescents tend to have more interest in music, movies, and global social media, and tend to be more influenced by global movements and brands. This interest, argues Arnett (2002) tends to stretch the period of learning well into adulthood. It is not surprising therefore to see that a sustainability approach to complexity would be superior to other approaches in embedding not only the financial, economic, and technological aspects, but also the psychological effects of globalization.

Mobility, migration and urbanization

The effects discussed of interaction are most visible in urban areas and in geographical locations with high mobility, both physical and virtual. Shifts in patterns of migration tell us a lot about the various dimensions of complexity discussed so far. In the 1960s the majority of immigrants went to developing countries, but by 2005, the majority (60% of flows) were going to high-income countries (World Development Indicators). There have also been tremendous variations in the regional patterns of migration: only 0.2% of the population in countries in the East Asia and Pacific Region is made of migrants—Vietnam has the smallest immigrant population. Despite changes in the patterns and trends of migration, there has been stability in the rate of migration: a steady percentage of the world's population is immigrating (about 3% between 1960 and 2005). In 2005, the data show close to parity in the gender distribution of migration: 95 million female and 96 million male.

While there has been stability in the rate of migration, there has been an increase in the volume of migration, growing from 70 million in 1960 to more than 190 million in 2005. Migration flows are also concentrated, with some countries receiving more people than others. There are five countries that have immigrant populations making up more than half of the total

population—Andorra, Kuwait, Monaco, Qatar, and United Arab Emirates. However, large volumes of people go to a few countries, making these countries have very large migrant populations; like the US, which tops the list, followed by Russia, Germany, Ukraine, France, Saudi Arabia, India, United Kingdom and Spain. The world has also seen a reduction in refugees: 8.4 million in 2005, down from 14.9 million in 1995 (United Nations, 2005).

The majority of migrants go to the big cities, which makes providing services to incoming residents a critical question. Similarly, when there is an economic downturn and there are fewer jobs to go around, there are negative impacts on recently migrating families, who find it difficult to get jobs and access to services.

There is a strong interaction between urbanization and increased mobility, with consequences for decision-making in a range of areas of policy—mainly because migration can also take place within a country (rural to urban). Such patterns have resulted in an archetype of urbanization, with cities of all sizes growing, but with a predominance of small cities and towns. The leadership capabilities to manage the provision of services in small towns and cities are often overwhelmed as the sizes sometimes triple or quadruple in a short space of time.

Consider Gaillac in the South West of France, which had a population of 10,315 residents in 1968. By 2007 the population had grown to 12,939 residents (CartesFrance.fr). Such a city falls under the last category of size used to capture city population dynamics of less than 500,000 people. The growth of Gaillac masks large transformations in the population; there were 5,692 people (46% of the population of Gaillac) aged less than 44 years in 1999, just before the boom in population growth. The number of people less than 44 years old grew to 6,509 (50% of the population of Gaillac) by 2007. There was a long period of time (15 years) where the population of Gaillac had actually been stagnant and even declined between 1975 and 1990. The challenge for decision makers is also to see how to manage such fast growth in a regional setting.

City managers perform vastly differently in their approaches and success levels in managing cities. Small cities tend to be better managed, with higher quality of life. Large cities are more challenging and few of them offer the same quality of life as small cities. Megacities, while even more challenging to manage, also have more resources and can compensate for the deterioration in quality of life by offering alternatives, like underground metro systems that reduce pollution levels, or green spaces and entertainment facilities that offer variety for their residents in terms of quality of life. Mid-size cities have all the complexities of large cities but not enough of the resources and they tend to have a challenge in meeting the quality of life expectations of their residents. Mid-size cities that succeed in maintaining a good quality of life attract more residents and become large cities. Such

patterns of performance result in migration toward small or larger cities, making mid-size cities quite unstable in their population levels, with ebbs and flows depending on the cycles of opportunity for jobs and other such drivers.

Simon Compaoré, the former Mayor of Ouagadougou, organized utilities services to meet evolving population sizes. Having more people means providing more services like water, electricity, and waste collection, which is a severe challenge to day-to-day as well as strategic management. More people may also mean more revenue and therefore provides a chance for technological breakthroughs and major jumps in service levels.

A higher demand for services than the leadership is capable of providing could lead to governance challenges, where the services are captured by those with more economic or political power, or when moving up the queue for services only happens when a bribe or a favor can be given. The complexity of interactions between political leaders, city residents, and service providers can result in a wide range of outcomes. Some outcomes are positive, with cities evolving to become well governed and with the capability to provide a high quality of life for their residents. Others deteriorate into weakly governed places with poor quality of life, where to get service you have to bribe or take measures into your own hands.

The pressure of globalization, which allows residents to be aware of the quality of life in other cities through increased travel and interaction, can lead to other outcomes. Kaufmann et al. (2004) show that indeed global cities that are well connected to the outside world are better able to control bribery in utility services, but also exhibit state capture by a few powerful interest groups. Well-governed cities outperform poorly governed ones, whether local or global, indicating the premium that good leadership offers in solving the service conundrum as city sizes evolve.

Disease burden: global responses to shifting patterns

Shifting patterns of disease are another area of complexity that leaders need to be mindful of. The appearance of epidemics over time has historically challenged leaders. The outbreak of typhoid in Greece during the years 430 BCE–427 BCE, known as the "Plague of Athens" had complex results on social norms and behavior, with lasting implications for governance (Finley, 1985; Zippelius, 1986). People stopped saving and investing and went into a consumption spree, believing they would not live long enough to enjoy the fruits of their hard work and earned savings. Respect for human life and courteous and honorable behaviors also declined according to historians. Such plagues occur even today, with some emerging and new strains reemerging. In August 2012 there were typhoid outbreaks in Harare and Chitungwiza in Zimbabwe, Kabwe in Zambia, and Kikwit in the Democratic

Republic of Congo. The source of the disease is contamination with fecal matter that happens when water and sewer networks are not properly maintained or when there is weak governance preventing important priorities from being addressed.

Shifts in the patterns of disease burdens also have important policy implications that leaders need to be aware of. Comparing the global disease burden between 1990 and 2020 indicates that lifestyle diseases like ischemic heart disease and unipolar major depression will rise to become the top disability creating diseases, while diarrheal diseases, lower respiratory infections and measles will decline, and tuberculosis and HIV will remain flat or decline slightly (Murray and Lopez, 1996). The accuracy of these predictions depends on whether new strains of diseases appear or if infections reappear because they were not treated in all locations in the world. Increased mobility and interconnectedness means that leaders need to be aware of any appearances and keep a watch, as they could turn into epidemics and catch countries unaware.

Leaders need to be aware not only of the conditions that lead to an epidemic or pandemic, but also of the best way of responding, the cost of responding, and the approach to managing cross-border effects of epidemics. Such disease patterns put a premium on balancing global and local leadership roles in ways that were not as necessary when there was less interaction across societies.

Water, food, and climate change: implications for development patterns

Water, food, and climate change also have implications for development patterns. Countries need to work together to manage water scarcity, and regions of the world need to collaborate to manage common water systems. Water is also a critical input for food production and agricultural productivity and competes for other uses like industry and energy production. Climate change has the potential to shift the patterns of available surface and underground water, with serious implications for choices to be made locally and globally.

Leaders need to develop regional strategies and policies for water basin management, as well as approaches to handle the suite of risks related to water shortages. Developing such strategies is necessary because water is at the nexus of many risks. Infectious diseases like cholera are waterborne. Pandemics like typhoid have their origins in water systems, as seen in the case of ancient Athens. There are numerous chronic diseases that are related to water—as seen in the impact of dehydration on bladder, prostate, and kidneys, as well as coronary heart disease according to Chan et al. (2002). Risk factors driving the availability of water come from external weather events like flooding or drought, or changing patterns of biodiversity. Human

actions that can alter the availability and quality of water include urbanization and migration and infrastructure provision. Changing patterns of available water can impact food prices and agricultural productivity.

Leaders need to decide whether or not to build secondary networks and have some redundancy in systems of water supply to avoid risks of water unavailability. Other decisions depend on analytical capabilities to identify and remove obstacles in the critical path, like maintaining embankments and inspecting sewer lines to avoid major disasters. Leaders need to have a set of actions to hedge against water-related shocks, like silos to store grain in the event of an elongated drought period. Some choices revolve around controlling for natural or induced risks, like avoiding leakage of sewage water into drinking water, which could cause a typhoid epidemic. Some decisions, like managing flood plains and managing secondary effects on food prices, require that countries work together and select amongst a suite of actions at the local and global level.

Investing in science and technology can render locations that are water-scarce viable. Desalination, making use of abundant sea water, and growing genetically modified drought-resistant crops can also transform deserts into fertile lands. Such use of science and technology is more important in countries where land scarcity and water scarcity co-exist.

According to the World Development Indicators and the World Atlas, arable land makes up 11% of total global land area (1.4 billion hectares globally). Europe and Central Asia have the highest level arable land per capita (0.57 ha per person). However, arable land per capita has declined by 19% in low-income countries over the past two decades. Africa is home to the largest amount of unused arable land in the world and has great potential, but has challenges in terms of the availability of water.

From a technology perspective, fertilizer use per hectare is highest in East Asia and Pacific and lowest in Sub-Saharan Africa (by a factor of 17). Using modern technology for agriculture in Africa could help deal with the effects of drought, as during the past 30 years Africa has experienced at least one major drought each decade.

The pressure on political leaders is high, as water is becoming an increasingly scarce natural resource, as can be seen in the increase in the number of water-vulnerable countries in Africa. Country leaders need capabilities that include the ability to raise agricultural productivity, find innovations that can work in drought stricken areas, manage food security, create regional food markets and improve the functioning of agricultural supply chains.

A good example of how leadership can transform agriculture, even in water-scarce zones, is the case of the African shea tree (*Vitellaria paradoxa*) which grows in the Sahel with limited need for water. The nuts from the tree, also referred to as karité nuts, are crushed to make butter or oil for all sorts of uses in cosmetics (creams, shampoos, moisturizers), cooking (as an oil), medicinal purposes (as an ointment), and to increase the durability of

wood and leather (see Dei et al., 2007; Dennie, 2012; Warra, 2011). Much of the production in Africa is now for sale in terms of exports and there is a lot of research ongoing on the uses of the nut. It is not surprising therefore to see that many countries have invested heavily in the production of shea butter. The top producing countries include Nigeria, Mali, Burkina Faso, Ghana, Côte d'Ivoire, Benin, and Togo (Table 3.1).

The example of karité nuts, coming from a low water use plant, is not unique. Some countries have focused their attention on transforming agriculture and its relationship to water, with spectacular results. The cotton supply chain is a good indicator of the choices countries have made and their results. China, India, and the US have been able to effectively increase the value of cotton by focusing on improving productivity levels from farm to export point.

Other countries, like Burkina Faso, have made major jumps by better utilizing science not only for cotton production but also for products as varied as karité nuts, okra, dried cow peas, and goat's milk. The production of goat's milk for export grew in value by 25% between 1967 and 2007. The seven highest karité nut-producing countries by value are all in Africa, with Burkina Faso ranking at number three by value of production (Table 3.2).

Burkina Faso has taken the lead since the 1990s in making major transformations in agricultural production. The country took advantage of the growing "green" and "health" movements to increase their annual production of critical lifestyle products like goat's milk, fresh fruit and vegetables, cotton lint, and karité nuts, amongst other products (Figure 3.1). Policy decisions in agriculture rendered cotton lint its number one commodity in 2007, coming from a ranking of 12 in 1967 (FAOSTAT, 2010). Karité nuts went from number 18 to number 15 during the same period. Fresh goat's milk went from a non-tradable good in 1967 to 13th in rank by exported value of the commodity in 2007 (FAOSTAT, 2010).

Table 3.1 Top producing countries of karité nuts in 2007 by value

Rank	Country	Value (US$ millions)	
		2007	2010
1	Nigeria	61	118
2	Mali	27	38
3	Burkina Faso	10	17
4	Ghana	10	16
5	Côte d'Ivoire	4	3
6	Benin	2.2	2
7	Togo	1.4	2

Source: FAOSTAT, 2013. Data for 2010 or latest available year can be found at http://faostat.fao.org/site/291/default.aspx.

Table 3.2 Top 20 producing countries of cotton lint (current million US$)

Rank	Country	Value ($ 000)	Rank	Country	Value ($ 000)
1	China	9,700	11	Turkmenistan	460
2	India	9,099	12	Egypt	415
3	Turkey	5,645	13	Argentina	412
4	USA	5,432	14	Kazakhstan	406
5	Australia	4,068	15	Mexico	201
6	Pakistan	1,234	16	Greece	174
7	Uzbekistan	1,677	17	Benin	161
8	Brazil	1,484	18	Burkina Faso	146
9	Nigeria	643	19	Tajikistan	145
10	Syria	541	20	Mozambique	28

Source: FAOSTAT, 2010. Data for 2010 or latest available year can be found under Food and Agricultural Commodities Production at http://faostat.fao.org/site/339/default.aspx.

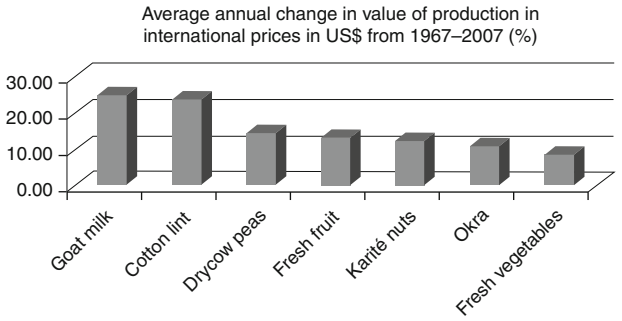

Figure 3.1 Transforming agriculture: Burkina Faso's capacity to tap into the "green" and "health" movements
Source: FAOSTAT, the data used in these tables are from 1967 to 2007 and is available at http://faostat.fao.org/site/291/default.aspx.

The ability of countries to make such transformations depends on how they manage the water cycle. Ethiopia is a relatively water-rich country, but its GDP is still tied to yearly annual rainfall variations. The leadership of the country selected agriculture as a key sector for transformation in an effort to address this dependency on rain-fed agriculture and even to export food in the coming years (Berhane, 2012). Ethiopian leadership has taken the role of transforming the link between agriculture and climate change at the global level, as seen in the role played by Prime Minister Meles Zenawi at the Copenhagen Conference in December 2009, with an effort to come out with a common African position (http://www.youtube.com/watch?v=ZK6EDUQBO7A). President Jakaya Kikwete of Tanzania used an initiative from the World Economic Forum to push transformation of agriculture through the private sector in Tanzania, including the use

of private investments for irrigation and effective use of available water (Elinaza, 2013).

Global trade: social and political implications

Global trade is another aspect of globalization that leaders need to be comfortable with in decision-making. Global trade patterns and their evolution are critical, not only for global brands and global companies, but also for leaders at the local, community, and country levels, if not regional or continental levels. Questions that loom large include whether globalization will lead to convergent or divergent tastes amongst consumers and its implications for particular brands. Other questions relate to the social and political implications of convergent or divergent preferences in society.

The case of beer is illuminating. Beer is one of the oldest products to be branded and one of the earlier ones to go global. Furthermore, while the beer market is highly consolidated globally, with four brewers dominating the global market,[1] beer consumption is influenced greatly by local tastes.

The top beer brands by value are Budweiser and Bud Light from the US. Corona, from Mexico, has managed to increase its value to the rank of number five in the world, coming from a country brand to become a global brand in less than 10 years. The rise of Corona has also had an effect in the rise of another Mexican brand Cruzcampo, which was ranked in 2007 at number 10, but did not manage to maintain its position in the top 10 by 2013. The oldest branded beer in the world is Kronenbourg 1664, which has been around, as its brand says, since 1664. Kronenbourg 1664 was ranked number 13 globally in 2007 and has managed to stay a top brand for nearly 350 years (Table 3.3).

Table 3.3 Global brands in specific product markets: Beer—top ten by brand value

	Brand	Brand Value (US$ millions)	
		2007	2013
1	Budlight	4,419	10,840
2	Budweiser	5,558	9,458
3	Heineken	3,699	8,238
4	Skol	1,283	6,520
5	Corona	3,286	6,620
6	Stella Artois	2,940	6,319
7	Guinness	2,718	4,473
8	Beck's	1,039	3,831
9	Miller Lite	2,104	3,093
10	Amstel	1,272	1,516

Source: Milward Brown Optimor and Brand Directory available at http://brandirectory.com.

Changes in brand value drive export volumes and vice versa. Of relevance to leaders from these trends are the roles that knowledge and access to ideas have on preferences and the role of learning in transforming societies. Consider that in 2013 beer brand values improved 36%, the greatest percentage brand value rise of all categories, including consumer and retail, food and drink, financial institutions, commodities, and technologies. Of particular relevance is the strength of beer brands in developing countries. Changing consumer preferences and habits, including concerns about health as more knowledge becomes available, in addition to economic pressures, all contribute to shaping the outcomes of individual decisions and their implications for company performance. Leaders need to be aware of these interactions and beer is a good brand to illustrate the effects.

Complexity and approaches to risk: options for functioning with low predictability

Skills for adapting to global constraints and taking advantage of the opportunities that come along with complexity and change are important, but so are capabilities to function with low predictability. There are two broad options for functioning in areas of low predictability: a cascading model that relies on probabilistic reasoning, and dynamic complex system modeling. The approaches are unique and their usefulness depends on context.

The cascading probability model

In the cascading probability model, failures in one system drive failures in the other, and risks are interrelated over time. A severe drought causes a sharp increase in food prices when the drought country is a net exporter—like wheat in the US—or if the commodity is a major staple in human and animal diets—as maize is. With the cascading probability model, the cross effect is weak below the critical points of failure. If a drought lasts for six months and causes farmers to miss a whole planting cycle it could have an impact on the prices of maize until the next planting cycle. If food prices remain high for more than six months, civil unrest and even revolutions can occur.

The frequency of cascades increases with the strength of the coupling between the systems—food prices are strongly coupled to drought levels, and hence the presence of severe droughts increases the probability of sharp increases in food prices. The speed of the cascade is higher when the system is close to the critical point—an extra week of drought in a food-sensitive region could make the difference between political and social stability and civil strife if the drought has already been going for several months.

Feedback of one system to the other shifts the critical point downward as a function of the strength of coupling between the systems—if the government is successful in controlling food price spikes due to policy

interventions then the effect of a longer and more severe drought on social stability may be reduced or attenuated.

At the critical point both systems become strongly coupled, acting more like a single system—severe and long periods of drought render a region incapable of producing food at affordable prices, famine sets in, and the region begins a cycle of dependency on food aid.

The dynamic complex system model

In the dynamic complex system model formulation, the behavior of systems is understood in a different manner from the cascading probability model. When the coupling is strong and two-way, there are constant failures in both systems—severe drought causes maize prices to spike; higher maize prices result in a switch by farmers to growing wheat instead of sunflowers; wheat requires more water than sunflowers; farmers consume more underground water for irrigation and increase the severity of drought on the replenishment of underground aquifers; and the soil gets drier and is unable to support higher food production, leading to a shortage of wheat and potentially severe famine and hunger in wheat-dependent countries.

When individual elements in one system are coupled to fewer elements in the other system, or when coupling is weak, cascading failures are self-limiting and there is a low probability of propagation. If some farmers switch from feeding maize to animals and feed them hay instead, they depend less on water-intensive maize farming, thereby shielding maize farmers from the impact of severe drought on food production levels.

When systems are coupled there is a possibility of multiple paths to failure. A severe drought can lead to a spike in wheat prices, thereby inducing farmers to grow more wheat. Higher wheat production leads to a decline in wheat prices, which causes farmers in the next planting cycle to switch to sunflowers. The next year wheat production is low since fewer farmers planted wheat and the severity of the drought reduced even further what little was produced, causing wheat prices to spike sharply.

The critical point of failure depends on increased nearest-neighbor coupling and increased cross-system coupling. Farmers in America grow maize to feed animals and small volumes are traded on the global market. A drought impacts maize farming in America, but has little effect outside due to the low levels of trade, and maize prices remain stable on a global market—the effect of low cross-coupling between drought and maize prices. If farmers in America were to sell most of their produce on an international market (strong coupling) and there were a drought that led to lower maize production, there would be a sharp rise in maize prices globally.

Synchronization of failure across systems increases with the size of the system and the number of interacting elements across systems. The introduction of maize for ethanol is a good example to show the complexity of multiple potential failure paths and the introduction of new dynamics.

Farmers in America grow maize for animal feed locally, for export markets, and for ethanol production in America. Fossil fuel prices go up globally, causing an increase in demand for ethanol. Farmers sell more maize for ethanol production than for food exports, and maize prices spike sharply. Ethanol becomes expensive and fossil fuel prices—which are weakly coupled to ethanol prices—remain high. High maize prices cause famine in other parts of the world that are net importers of maize.

All these examples illustrate that there is a higher possibility of really large failures when systems are coupled and the cross-coupling is strong. Such effects can be seen in maize and fuel prices, and also in the spread of epidemics.

Options for functioning in areas of low predictability: role of scenario analysis

Scenario analysis is needed when predicting the outcome of interactions is difficult or impossible. This could be because decision makers are facing sudden collapse after long periods of stability—for example, inflation levels were low and manageable and the economy starts to face high inflation rates all of a sudden. Difficulty in prediction can also occur during periods of rapid change, especially when followed by periods of little or no change, and it is not clear what is likely to happen next. Alternatively, there can be visible but small initial variations leading to large differences in later outcomes—a young vegetable vendor sets himself on fire on December 17, 2010 in Tunis in protest against the confiscation of his wares and for being harassed and humiliated by the municipal officials. His act becomes a catalyst for the Tunisian Revolution between December 2010 and January 2011, and the more widespread Arab Spring,[2] which resulted in the ousting of leaders from power in Tunisia, Egypt, Libya, and Yemen and civil unrest in other countries (Al Jazeera 2010-12-20). These examples also illustrate how a small change in one place could lead to large change in other places.

Scenario analysis helps define the actions and strategies to adopt as outcomes approach pre-defined patterns. Evolving scenarios helps decision-makers find leverage points—how to meet the demand for jobs for young people before they result in a revolution? Scenarios can also aid in finding the most significant trade-offs—short-term job creation versus longer-term structural change to address youth unemployment, for instance. Scenarios can help leaders develop adaptive strategies that change as the reality on the ground changes, allowing them to know in advance which zones of outcomes to avoid, as they are irreversible or the consequences very severe. Scenarios also help leaders select from a series of approaches—among types of agents (individuals, groups, young people), location of agents (cities, rural areas, borders), capabilities of agents (self-motivated change makers or good organizing skills), and types of strategies (sharp and targeted change through messages on YouTube or slower long-term change through Wikipedia).

The probabilistic models and dynamic complex system models can be used to select the most appropriate set of actions.

A good scenario will rely on analysis of what is probable from history and from case studies. When the historical or case study outcomes have been mapped out, they can be assessed against a range of possible futures: relevance, plausibility, and logical consistency. Leaders can then form hypotheses about what might happen and the implications of alternate outcomes, as well as considering outside-in and divergent options. Leaders can subsequently decide whether they act as if the probable outcome from history could be worse, with the situation or outcome deteriorating further, improving, or staying the same. The actions can be to seek to reverse or improve the outcome, muddle through, or speed up and escalate the deterioration or decline.

Three key factors are important in identifying a good scenario. The first is to seek a good balance between *variation* and uniformity—provide enough options that assume patterns will remain the same or change, for example. Types and patterns of *interaction* are also important factors to include in any scenario. Approaches for *selection* amongst successful strategies and agents would involve choosing from the types of strategy, location, and capabilities of different agents (Figure 3.2).

Defining the interactions is always a good starting point for building effective decision-making scenarios. The first level of choice relates to the *types of interaction* mechanisms: what structures and processes govern interaction between agents and agent types—for example between farmers, markets, food prices, and water use?

The second choice to make is the *level of interaction*: at what level are the key interactions taking place (agent to agent, agent to environment, agent

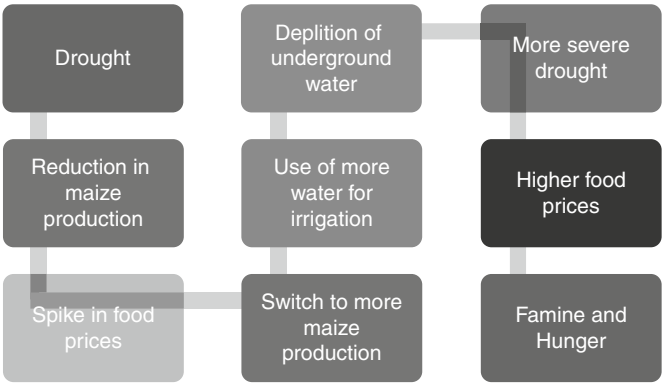

Figure 3.2 Interactions in agriculture, economics, and environment

to instance)? Are farmers directly interacting with food markets and global good prices?

The third choice relates to policy: what *types of policies* would influence the interactions (external, internal)? Should there be price controls for key staples like maize? Should maize be used for ethanol production? Should farmers be allowed to irrigate their maize crops during drought periods?

Finally, decision makers need to have measures: what *types of measures* would be used to assess the impact of the interactions identified? Is it the level of maize production, the price of maize on the global market, the share of maize going to ethanol production, or the number of incidences of famine and hunger?

Once the interactions have been detailed out and choices made as to what types would be retained in the scenarios, leaders need to build redundancy or slack to limit failure frequency in the event of negative outcomes. Another critical exercise is to identify and then remove or avoid critical paths, or paths that would lead to failure and bad outcomes. Identifying and hedging against sources of shocks is also important and needs to be built in. Decision makers can then decide to increase or reduce coupling to better redistribute stress or prevent cross-element transfer of stress. Control for natural or induced failure cascades is also needed. For a detailed review of the behavior of complex systems, see Bar-Yam (1997).

Finally, there is a need to seek balance between local actions to postpone failure versus longer-run coordinated actions to handle failure more permanently. The credit market squeeze of 2008 is an example that needed coordinated actions in the short run by all central bank governors to manage the crisis. The euro crisis of 2011 required a combined series of short-term coordinated actions—like the fiscal pacts signed by member countries—but also coordinated actions in the long term, such as the role of the European Central Bank and the degree of autonomy that needs to be given for it to act on behalf of member states, bringing the system to a tighter coupling.

Managing the level of interactions is also important for a good scenario to work. Starting with the types of agents, decision-makers need to manage the interactions amongst people (central bankers in a fiscal crisis, population growth in a resource depleting world, aging and youth to better manage retirement and job creation). Agent types could also be companies (choosing to support particular industry types in a structural economic setting with defined industrial policy, managing the size of an industry to control monopolistic tendencies). Agent types could also be countries (neighbors and their effect on a local economy, trading partners, competitors, states at war) or associations (of key stakeholders like labor unions, farmer organizations).

Once the agent type is defined, it is important also to look at the location of agents. For example, in migration and emigration policy the agents are

mobile, as they are in cases of urbanization and city growth. Population concentration in coastal areas could also be an agent location-sensitive area to manage if what you worry about is effects of climate change on rising sea levels. The capabilities of agents in terms of communication, knowledge, and learning, as well as mobility, are also key factors for the building of effective scenarios.

Strategy is the next thing that decision makers need to have in mind. What types of strategy would be used: trial and error, experimentation and learning, or some other approach? The type of response to a set of actions also forms part of the strategy component of scenarios—what to observe; how to evaluate and shape different strategies; when and how to react and respond to a set of outcomes; and how to learn, understand, and adapt to materializing effects.

A strategy will evolve with the type of environment, instance, or context in which it is applied. The environment of application could be stable or volatile; open or closed; long history, little or no history; shifting preferences, identities, behavior; and shifting nodes of control. For example, in an agriculture-dependent economy, price controls on maize can have a serious effect on production (as farmers make local decisions on what to grow) and hence GDP and incomes. Similar maize price controls in economies dependent on services may have limited effects, such as on milk (due to the knock-on effects on animal feed prices), and attenuate before they impact the overall economy (as consumers adjust to consume non-dairy products).

Within a strategy, decision makers can also build in controls or external policies that govern what outcomes are going to be or should be permissible. These policies relate mostly to barriers to movement, permeability, or sequencing of barriers. On barriers to movement, decision makers make choices of policies that could be physical, such as immigration and national borders or physical walls (which controlled entry and exit in medieval times, fell in the sweep of democratization in Berlin, or are to be erected in modern times, as at the Mexico–US border); trade barriers (import fees, quotas, agreements); membership requirements (G7, unions, associations, clubs); and channeling exchanges through communication and infrastructure (roads, telephones, Internet). Barriers could also be conceptual, such as ideas (human rights) and beliefs (democracy; citizenship, castes, and clans). Permeability of barriers is also a decision. Religious organizations choose the degree and possibility of conversions as a sort of permeability into the system. Email filters that block out spam are an example of the degree of permeability. Immigration policies are also an exercise of policy that limits or allows permeability into a country's borders. Decision-makers can sequence the barriers, deciding to use different barrier types sequentially, or may make parallel use of some barriers, and so on.

In addition to external policies, decision-makers can also rely on internal policies for a good scenario. Internal policies could include creating followership through varied forms of apprenticeship, defined work practices, select trading partners, elaborate religious ceremonies, refined musical forms, or even the norms around social roles. Other choices of internal policy are signaling devices, like prices, brands, fashion and trends, tags, or peace agreements. Boundaries are also a form of internal policy that can be used to define political and ideological clustering, religious concentration, social clustering, or levels of ethnic integration. The time scales for action or decision are internal policies that can be used to decide whether strategy and vision should be driven at the top or using a bottom-up approach; whether actions need to be slowed down or speeded up to get the desired effect; and whether it is preferable to have slower or faster action at the bottom or at the top. Stress distribution is an important internal policy, including choices like the risk management strategy to use, how much redundancy to build in, how much independence or coupling to create or allow between systems, what actions to use to build up to criticality where large scale change takes place, managing the size and frequency of change (by exploiting the power law if possible), and inducing correlated shocks or not. Policies at the internal level could also include routines and schedules like total quality concepts, feedback loops, and work manuals. Internal policies may be designed to interact with external policies as varied as restructuring physical and conceptual spaces by introducing censorship, engaging in trade, and encouraging or discouraging tourism.

How do you measure success to get adaptive change? How do you define success? How do you evaluate payoffs? These three questions are important to include in any scenario. To get adaptive change, performance should be measured within the system of interest to decision makers. This is because the measures can be modified to adapt to the lessons learned, adopted, or disregarded by the agents based on the reliability of the measures as indicators of success. How success is defined affects the chances for effective learning. If the purpose of a scenario is to learn easily, then there should be more *tolerance* built in for failure. If success is intended in the long run, then *patience* needs to be built in the scenario, compared to searching for quick wins in the short term that may jeopardize the chance for deeper success in the long run. Decision makers can consider a short-term criterion that may not include *winning* in the near term and that requires having the stomach to tolerate failure. Traders in the stock market make such choices on a daily basis. Other measures of performance are related to assessing or evaluating the payoffs for a given set of actions. Is an action too expensive to do? Do you have to wait too long for a result? When the result is achieved, will it be easy or difficult to attribute reasons for success?

Table 3.4 Selection and payoffs

Level/Criterion	Cost	Speed	Attribution	Application
Agent	Expensive	Slow	Low	M&A, spinoffs, restructuring, elections
Strategy	Cheap	Fast	High	Stock market, social mobilization
Tradeoff	Acquire agent or copy strategy	Do it yourself or buy	Context preserving or action preserving	Country strategy, trade negotiation
High selection pressure: excellence but less diverse (exploitation)				
Moderate selection pressure: average but more diverse (exploration)				

Building all the options defined above into a scenario-generating process results in a set of scenarios to choose from. So how do you select from among a set of credible and well thought out scenarios (Table 3.4). Three aspects aid the decision maker in choosing amongst a set of credible scenarios. The first is the degree of variability in the scenario: what will be changing and how (people, economy, environment, technology, institutions)? The second is the type of anticipated strategic shifts: what should you change; what should you keep uniform; and what should you vary in your approaches? Finally, the important question of experimentation and learning: how much should you exploit what you already know and how much should you invest in new areas of exploration and learning?

Typically, agent-level criteria are expensive and slow to generate results, and when results happen it is difficult to assign or attribute cause for success. The Arab Spring is a good illustration of the agent-level change and its payoff—the change was sparked by the action of a single agent (the vegetable vendor's decision to set himself on fire in protest)— and was sustained by a group of agents using strategies that were physical (through rallies, marches and demonstrations) and virtual (through communication and organization using Twitter and Facebook). It is not easy to attribute the result of the Arab Spring to a single agent or strategy. Agent-level change has useful applications in areas such as mergers and acquisitions, where a single company or business line can be selected to drive the process of change; managing spinoffs from companies in order to encourage innovation; and restructuring economies, where a specific group of agents (say agribusinesses) are used to drive structural change (building small-scale manufacturing capability using the food industry). Election strategies typically use a combination of agent-level strategies, such as relying on student support in universities, labor unions, business associations, and so on.

A strategy-level criterion is cheap and fast, with a high level of attribution, and can be used in a wide variety of practices. Social mobilization to get increased use of contraceptives is an example, or strategies to reduce malaria by supplying bed nets, where in both cases there is a direct link between strategy and result. Stock market trading strategies also fit in this category of cheap to do, fast to see, results, with high attribution of success or failure to the type of strategy.

When using tradeoffs to choose amongst criteria, a decision-maker needs to respond to a series of questions. Is it easier for you to acquire an agent or copy a strategy in order to reduce the cost of the scenario? An illustration of whether to acquire an agent or copy a strategy is the choice Africa needs to make to restructure its economies and become more sophisticated and industrialized. Should it do so by picking its own companies (agents), which have some sort of rudimentary mechanization and industrial capability, and support them to grow in the way South Korea did (copy a strategy), or should it buy light manufacturing capability from China (acquire an agent), as suggested by Lin (2012).

Another key question is around the speed of change. To get speedier results should you do it yourself or buy the service from another agent? Following the end of the Rwandan conflict in July and August 1994, the country embarked on a capacity-building strategy to get rapid results (see Majeed, 2012). It engaged the Ministry of Local Government in a pilot to reduce poverty in Gashaki in North Rwanda. The focus on rapid results improved the ability of local officials and leaders (agents) to help their families raise their income, and it also improved the ability of public servants (agents) to deliver services effectively. Therefore the rapid results approach is a strategy with high attribution and fast speed of attaining results, but it was considered a high-cost approach for getting change (http://resourcecentre.pscbs.gov.rw/content/reports-and-studies-0).

The Rwanda case raises another key question to consider in selecting scenarios on the basis of payoffs, particularly if you wish to get the right attribution. Should you seek to preserve the context you are intervening in or the actions you are engaging in? In the case of Rwanda, the interventions were with communities that had just come out of severe conflict, and the intention was not to preserve previous behaviors, but to seek change in behavior in a short period of time (not context-preserving). The agents intervening in the process were public servants and the rapid results strategy was aimed at preserving their service delivery functions while speeding up the attainment of results (action-preserving).

Adapting to actions of other agents

Being aware of the actions of other agents is critical in shaping the global properties that affect your decisions. The microcosm of decisions made by

city leaders helps us understand the role of complexity in shaping decision-making strategies. In particular, how citizens interact with mayors and firms in a variety of city types is a rich source of learning how to adapt to the actions of other agents. One may also look at choices made at a continental level and the variety of scenarios possible at that level, as illustrated in this section by looking at the evolution of cities and urbanization as well as the potential for different scenarios in Africa.

Cities and scenarios

A measure of a successful city could be its size. A well-functioning city would attract migration and location choices of firms and the city would grow. City size over time could be the criterion for judging the success of a strategy. Long-run patterns of city size indicate that this is a very dynamic process of change, with cities starting off small, growing steadily, growing and then shrinking, or not growing at all, and even dying (see Léautier, 2006). As seen in Léautier (2006), the number of small cities over time grew dramatically between 1975 and 2015, but so did the number of megacities. However, the number of medium-sized cities has not grown as much and the shape of the curve of city population over time has become sharper over time, with a bigger differentiation between small and megacities. Such patterns belie a differentiated set of dynamics, depending on size or a varied set of actions that lead to different outcomes on size. Since size was selected as a performance measure, it is used for the latter interpretation.

Ouagadougou went from a small city in 1960 (where it had a population of 59,000) to a large city by 2012 (with a population of close to 1.5 million). Ouagadougou became attractive to people who moved in, companies that located there, and to international and regional agencies that also located there. The city performance outcomes observed in Ouagadougou and other cities like it, which can be referred to as attractiveness, derive from a series of interactions. Political interactions between residents and their leadership (mayor, city manager) drive the internal policies that govern city management. The commercial interactions between residents, politicians, and the firms who choose to invest in those cities shape the productivity outcomes at the city level. Communications between and among residents as they pursue their cultural and social interests determine the quality of life of city residents, which has an impact on city size in the long run.

A wide variety of scenarios can be built using three agents (citizens, firms, mayor), the level of interaction amongst them (local or global), the type of interaction (service, political), and the selected payoffs or performance measures (size, productivity, quality of life).

Regions and scenarios

Scenarios can be built at continental level. Consider the case of Latin America, where you could build three potential scenarios. In one there is

more coordinated effort at the continental level, with continental ownership of policies and decisions, and leadership that shapes the choices made for the whole continent. Another scenario could be where sub-regional entities, like the members of MERCOSUR (the economic and political agreement among Argentina, Bolivia, Brazil, Paraguay, Uruguay, and Venezuela), work together in a mosaic. Finally, one could consider a continent that is shaped mostly by decisions from outside, in a sort of externally driven nation states scenario.

Scenario 1—Coordinated Effort Choices can be made in the first scenario to define the internal and external policies. Under the continental leadership and ownership scenario, efforts could be made to ensure Latin American leadership and ideas on a global scale. This can be secured by ensuring that the polity owns the economic growth agenda through participatory techniques. Latin America could lead innovation in key sectors such as agro industry, petrochemicals, and metallurgical industries. Home-grown solutions to drugs and crime would be built on traditional principles and would flourish, and there would be no outside intervention in domestic crimes. Latin America would wield leadership and would be represented in international institutions and debates. An outcome from such policy choices would be to drive Latin America faster towards international parity. Latin American standards of governance would be internationally accepted and there would be no need for institutions such as the United Nations Office on Drugs and Crime, with Latin Americans trying their cases using domestic judicial systems and processes. Latin America would be contributing in a significant way to the international architecture in areas such as trade, finance, environment, migration, and debt. At the country level, Latin American institutions would be resolving conflicts and preventing violence and crime (including the drug trade) using domestic, regional, and continental institutions. Services would be provided effectively in the areas of health, gender parity, water, and education.

Scenario 2—Sub-regional Mosaic Under the second scenario, there would be some models of success, as in some of the members states of MERCOSUR (say Argentina and Uruguay), but limited learning from each other at the continental level. There would be a large variety of outcomes in the quality of democratic and economic governance, with some countries doing better than others. Performance would also be differentiated under the sub-regional mosaic, which would be more realistic, focused on performance and results and managing interdependency while mastering strategic planning.

Under the second scenario, countries would engage in bilateral strategies (say Bolivia and Venezuela) with *ad hoc* cooperation, and a few prominent countries (say Brazil or Mexico) would drive the external agenda. Outcomes would be visible but uneven, with isolated successes in service provision in

the health, education, gender parity, and water sectors. External aid would be driven by external security needs and donor-based evaluations of capacity and need.

Scenario 3—Externally Driven States This scenario is gloomier. It requires attention to adaptability and resilience, focus on managing uncertainty from conflict, dealing with climate change and managing external conditionality on development aid. In such a scenario Latin America would be reacting to external threats, such as new technologies and business models, threatening domestic production. Governance standards for the continent would be externally set and Latin America would be severely underrepresented in international forums and debates. Countries would have weak capacity to manage, having trouble dealing with ethnic, drug-related, and political violence.

Weak country institutions under Scenario 3, caused by lack of capacity to analyze and implement policies, would react to international imperatives rather than drive them. Access to the benefits of globalization would be determined by bilateral and multilateral organizations with little input from Latin American countries. Country conditionality would be the norm for allocating aid to aid-dependent countries. Service provision would vary across countries and would be heavily dependent on the international civil society. Donors would practice selective aid provision with specific conditions going to specific programs.

Values and behaviors as a guide in the face of complexity and risk

When faced with complexity and risk, it is difficult to make choices. In the absence of any previous strategies or lessons to learn from or case studies of relevance, what remains as a guide is the set of values and behaviors deemed appropriate at the time of choice making. The first step in building the right values and behaviors comes from better knowing the self. How do you form judgment from observation and self-knowledge? How do you build awareness of blind spots? Is the truth what you can observe or does it come from challenging observations with new information? How do you learn to endure the pain of knowing what the outcomes of your actions will be? What would be most useful to use, facts and evidence or a set of mysteries and beliefs, to get results in a particular setting?

The skills needed to define the values and behaviors that can serve as a guide in making choices can be arrived at through reading, through case studies, as well as through lifelong learning in the real world. This book covers mostly what you can learn from cases and simulated practice sets.

A leader will ultimately have to choose from a set of scenarios, policies, actions, and so on. Any outcomes from those choices remain the

responsibility of the leader. Choice is therefore value-ridden and leaders need to have not only the freedom to choose from a set of actions, but also to bear the responsibility that choice brings. Leaders need to go beyond faith and engage in active choice making. They have to push themselves to replace their prior beliefs with reason, in order to engage in the right scenarios. Leaders need to make choices in the face of suffering, knowing that their choices could cause harm to others.

Decisions move very fast in a globalized world, and leaders have to constantly learn and adapt, which calls for constant attention to self-development. Some tools can be useful for self-development. I have personally found 360-degree feedback very useful in learning about my blind spots. Client feedback and dialogues with peers can also sharpen your skills and allow you to test your value system against others. Practice and experimentation, as are encouraged in the case material and exercises in this book, are very helpful in leading you through a learning process with results. Discussions with friends and family as well self-learning and reflection and reading are all tools that can be enormously helpful in shaping and honing a set of values and behaviors that are necessary to navigate in a complex decision setting.

The nature of leadership is also quite unique and it is important to know the limits of the self and the challenges that leadership presents. One cannot build a scenario without a good understanding of the nature of human conflict. While reading and reflection are useful for learning, one has to sharpen learning through practice and experimentation. The following series of practice blocks and cases support the learner in their journey with practice sets that build skills and sharpen insights.

Co-sensing and co-creating a superior risk management strategy

A practice block providing a case study on the SARS epidemic offers practice of the skills needed to lead in complex and fast-changing risk scenarios.

The SARS epidemic case study[3]

As globalization increases it is more likely that an infectious disease that emerges in one country will be transmitted rapidly to another. The severe acute respiratory syndrome (SARS) is a recent example. What started with a "small notice" in the *Weekly Epidemiological Record* of the World Health Organization (WHO) in early 2003, reporting five deaths from an unknown acute respiratory syndrome,[4] turned out to be a highly contagious disease that managed within a matter of weeks to spread from the Chinese province of Guangdong to the rest of the world – eventually infecting individuals in 37 countries.[5] The first case outside China had been reported on the 26th of February, rising to 8448 cases by July 2003, with a total of 774 human deaths.[6] Although many people had feared that SARS would rival the

influenza pandemic of 1918, which killed around 40 million people, it did not lead to the devastating health impact that many feared.[7]

SARS originated in China in 1996, when a highly pathogenic virus was isolated from a farmed goose in Guangdong province. By 2003, events in humans had been reported in China and events in animals reported in the Republic of Korea, Thailand, and Vietnam. In 2004 other countries reported events, including Japan, Cambodia, Laos, Indonesia, and Malaysia. By 2007, SARS events in animals had been reported in nearly 60 countries:

Afghanistan, Albania, Austria, Azerbaijan, Bangladesh, Bosnia-Herzegovina, Bulgaria, Burkina Faso, Cambodia, Cameroon, China, Côte d'Ivoire, Croatia, Czech Republic, Denmark, Djibouti, Egypt, France, Georgia, Germany, Greece, Hungary, India, Indonesia, Iran, Iraq, Israel, Italy, Japan, Jordan, Kazakhstan, Republic of Korea, Kuwait, Laos, Malaysia, Mongolia, Myanmar, Niger, Nigeria, Pakistan, Poland, Romania, Russia, Saudi Arabia, Serbia-Montenegro, Slovenia, Spain, Sudan, Sweden, Switzerland, Thailand, Turkey, USA, Ukraine, UK, Vietnam, West Bank Gaza

Twelve countries have reported cases in humans:

Azerbaijan, Cambodia, China, Djibouti, Egypt, Indonesia, Iraq, Laos, Nigeria, Thailand, Turkey, Vietnam

At the time SARS appeared, I was working at the World Bank and had been traveling quite regularly to China. On a cold February morning in 2003, Lystra, my special assistant, rushes into my office with a piece of paper in her hand. "Sorry Lystra, you need to wait for a while as there is a whole set of meetings the Vice President needs to go to and I cannot have you coming in here without an appointment" says Alice, my Executive Assistant, firmly shutting the door behind her as she exits the office with a bunch of files in her hand. A few minutes later Alice buzzes me saying, "I really think you ought to see this." Lystra walks in with an anxious look on her face still clutching the piece of paper in her hand. "I am not one to be alarmed, but this looks like something we need to worry about as you plan your trip to China." She hands me the piece of paper and looks at me as I read it (Box 3.1).

Box 3.1 Outbreak News[a]

Acute respiratory syndrome, China—Update

On 20 February 2003, the Chinese Ministry of Health reported that the infective agent in the atypical pneumonia outbreak in Guangdong Province, which affected a total of 305 persons and caused 5 deaths, was probably *Chlamydia pneumoniae*. Further epidemiological studies are underway and are coordinated by the Guangdong provincial health department."

It was an article from the *Weekly Epidemiological Recor*d No. 9, 2003, p. 57. "Lystra, this sounds like the outbreaks that appeared before, perhaps as far back as the 1990s in Taiwan." "Take a look lower down at the third record on the bottom of the page." she says anxiously. I read on:

Influenza A(H5N1), Hong Kong Special Administrative Region of China—update

As of 20 February 2003, the Department of Health in Hong Kong SAR confirmed that a 33-year old man, who died in hospital in Hong Kong on 17 February, had been infected with a strain of the influenza A(H5N1) virus. A nasopharyngeal swab taken from the man and tested in the Government Virus Unit was positive for influenza A(H5N1).

The 33-year old man is the second case of influenza A(H5N1) virus related to this outbreak in Hong Kong SAR. The man is known to have been the father of the 9-year old boy reported as testing positive for influenza A(H5N1) on 19 February. Both cases had traveled to Fujian Province (China) in January. Two other members of the family who accompanied them to Fujian in January have also been unwell. The mother of the family has now made a full recovery; the other affected member of the family (an 8-year old girl) died on 4 February in Fujian Province.

[a]The two excerpts are taken from *Weekly Epidemiological Record* No. 9, 2003, 78: 57–64 http://www.who.int/wer.

I remember the feeling in my stomach as I looked up at Lystra and saw her grave look. There was indeed reason to be alarmed back then. The reported cases were to have an impact on travel around the world as the reports made by the WHO in that *Weekly Epidemiological Record* of deaths from an unknown acute respiratory syndrome would turn out to be a highly infectious disease that would spread out from Guangdong to the rest of the world. By 2007, SARS events in animals would have been reported in nearly 60 countries, and 12 countries would have reported cases in humans. But I also had to be cautious of the potential impact that officially sanctioned information (such as by the WHO in the case of SARS) could create panic and could boost the profits to the pharmaceutical industry.[8]

Epidemics and their effects

The SARS epidemic served as an important opportunity for a number of stakeholders to study and test the existing strategies and information systems on a scenario the global community had not yet known before at this scale. A previous pandemic in 1918, which killed 40 million people, was foremost in the minds of policy makers and researchers at the outset of the

SARS breakout, as many feared a similar scale of impact. Indeed, the pattern of emerging and re-emerging infectious diseases was made more serious with the increase in globalization, as it is more likely that an infectious disease emerging in one country could be rapidly transmitted to another. Frequent travel across countries and the increased export of food and other products across the world have made the risks that were limited in the past to be orders of magnitude more serious. The SARS case was a sharp reminder that an obscure event in one country could easily have serious global consequences.

The experience of SARS was also to test the functioning of collaborative and multi-centered research and policy decision-making bodies to identify causative agents and develop diagnostic tests.[9]

In addition to the concerns about human health, many other stakeholders in industry were equally concerned. There was immediate concern about travel and tourism, impacting primarily the airline industry as people changed destinations or preferred to stay home. News reports on passengers being asked to exit aircraft due to wheezing and coughing symptoms abounded, and many who did not need to travel cancelled their trips. Those like us who had to travel into infected zones had to go through temperature scans at arrival in Beijing, for example, and witnessed fellow passengers being pulled aside due to the slightest indication of a fever. To this day passengers are scanned as they enter global city airports like Johannesburg. The panic reaction to the epidemic has also been blamed for the collapse of Asian tourism in 2003 and provides a good case for caution about transnational crises and the approaches to reacting to them (McKercher and Chon, 2004).

The chicken export market was affected directly as the world market for meat exports had grown dramatically since the 1990s. Health impact studies reveal that the global macroeconomic impact of SARS was at $ US 30–100 billion,[10] affecting a wide range of sectors, but particularly travel and tourism. The SARS outbreak had far-reaching implications for other industries, as seen by the sharp decline in the export of products related to the chicken value chain. The big producers of chicken meat for export—China and the USA—were impacted, as can be seen in their export patterns as the epidemic took hold.

There were a variety of responses from industries and countries to the SARS epidemic, with some benefitting and others losing out in the chicken export business. Effects could be seen in all the key economic indicators, including the volume of chicken exports, the value of the exports derived, and the price per ton.

As I was reading an article in the online version of the *Guardian* at www.guardian.co.uk on my iPad on June 1, 2011 while waiting to board a flight from Johannesburg to Harare, a small headline caught my attention. "*E. coli outbreak in Germany adds 365 more confirmed cases*" Germans warned against

eating raw lettuce, cucumbers, and tomatoes as the cause of the outbreak, centered on Hamburg, remained a mystery. The mysterious German *E. coli* outbreak that had killed 16 people showed no sign of abating, with 365 new cases confirmed on Wednesday.[11]

I remembered the day Lystra rushed into my office in 2003. I thought about how at the time we responded to the demands by country clients in dealing with the SARS epidemic. The capacity needs were indeed complex, with some of the issues having relevance at the levels of the national health systems, and others stretching across countries and requiring international and coordinated responses. Then there are the complexities of the interactions between farmers, meat factories, meat exporters, butchers, supermarkets, consumers, and policy makers. Each of them had a complex set of actions they needed to take to manage risk, whether at the production, export, packaging, or consumption levels. All sorts of policies were also at play. The policies had differential impact on the outcomes.

Globalization, and particularly the ease of transport, had caused an expansion of the world market for chicken prior to the SARS epidemic. The appearance of SARS was close to a nightmare scenario for chicken farmers and meat exporters. Brazil, the US, Germany, and the UK saw their exports of chicken meat increase, despite the SARS epidemic. China, Thailand, and the Netherlands witnessed a sizeable decline in their exports following the epidemic (Table 3.5). France had a slight decline in its exports. What was different about their approaches and why was the pattern of responses so different?

The different reactions and the national contexts were largely responsible for the variation in the domestic responses across the affected countries. Some countries switched strategies, to enter the market for live animals rather than selling meat. Other countries, such as Germany, France, and the UK were able to absorb the decline in exports seen in other countries (such as the decline in American and Chinese exports[12]) with less devastating effects.

Because SARS originated in Southern China, the mainland's chicken-farming hub, poultry exports in the region were badly hit. As an immediate result, for example, Thai exports were boosted[13] for a couple months,

Table 3.5 Country responses: chicken meat exports 1984–2004 (value in US$ millions)

Year/ Country	Brazil	US	Netherlands	France	Germany	UK	China	Thailand
1984	264	225	239	299	17	13	35	60
1994	607	1249	757	640	85	114	357	382
2004	2454	1785	536	623	332	284	123	44

Source: FAOSTAT (2007) or latest available year can be found at http://faostat.fao.org/site/291/default.aspx.

though unfortunately they ended up in an even more devastating decline when the first Thai chicken was diagnosed with SARS in November 2003 as a result of the spreading of the pandemic.

What was common to all countries was the immediate need for individual as well as collective responses of a variety of stakeholders, including the media, consumer groups, and business associations, in order to address the political, economic and diplomatic challenges of such a worldwide issue. The "small notice" from February 15th 2003 had turned into a problem to be dealt with internationally.

These were the sorts of issues running through my mind as I saw an email come in with a request to the Fezembat Group to summarize the lessons learned from the SARS case for application to other infectious outbreaks, such as the *E. coli* outbreak in Germany. I responded to the email with some advice on the questions they could ask while seeking the lessons learned from the SARS case, asking Serge, the young researcher, to look particularly at how stakeholders can be ready for small events that end up becoming global crises. What techniques can be used to speed up information, analysis, and action across multiple stakeholders when faced with low-probability–high-impact events? Are there ways in which stakeholders can act that would make them better at handling these types of events? When I arrived in my office in Harare I dug up the information I had about the SARS epidemic to see what could be gleaned from it and sent it off to Serge. Alas, other pressing matters at the Foundation prevented me from doing more. The young researcher would have to carry out the analysis and be ready for the client request that had come in, with limited support. The guidance I provided Serge is outlined below for the learner to use for his or her own purposes. This guidance has also been tested in a classroom setting and has proven very useful in soliciting multi-stakeholder groups to co-develop an approach to a crisis.

Lessons from the SARS case study

The practice block Box 3.2 below can serve as a guide to the learner for broader applications.

Box 3.2 Practice Block III: Co-sensing and Co-creating a Superior Risk Management Strategy

Premise: A team of stakeholders facing a common challenge would bring different perspectives to the table, allowing them to devise a better set of actions to handle emerging risks.

Objective: to practice the skill of co-sensing the key risks and co-creating strategies and actions that could serve as a prototype for handling the challenge.

Lessons: the case of the chicken export industry shows the value of co-developing a set of potential scenarios that could have played out and their respective courses of action. Looking at how different agents adjusted to the same epidemic can be helpful in assessing the relevance of different strategies and actions. Such information is critical when designing prototypes to pilot with in similar situations.

Skill: The main skill of value in this case is working with others to sense what they may be sensing and creating together an approach for dealing with a common risk with varied but serious implications on all key stakeholders.

The outcomes of the SARS epidemic

In reality, the chicken industry was deeply affected by the crisis, because of the gravity of the disease and because of the patterns of the globalized economy. It was the biggest crisis of its kind that had occurred in the developed world in contemporary times. SARS was the first new disease of this millennium, and in some ways the most dramatic of all. It rapidly achieved notoriety through outbreaks in Hong Kong, the rest of China, Vietnam, Singapore, and Canada as a readily transmissible infectious disease with a significant mortality rate (11%) and global economic consequences. The outbreaks in early 2003 spanned 30 countries in six continents, causing estimated losses to the countries of $30 to $150 billion. Yet by July 2003 they were largely controlled, appearing thereafter in minor ways with less global disruption.

In the form of SARS, Asia endured its greatest economic challenge since the currency crisis of the late 1990s. The chicken export industry that was hit saw a sharp decline in exports—specifically service exports, such as tourism. Prior to the SARS outbreak, the region's airlines, hotels, and restaurants were already experiencing soft demand as a result of slow world growth during 2001 and 2002. That slump turned into a catastrophe for the region, as vacationers diverted their travel to safer destinations. Furthermore, the direct impact of reduced traffic yielded significant negative multiplier effects. Initially, hotels and restaurants required fewer housekeepers, waiters, and maintenance personnel. Thus, service employment, which had been growing strongly in the region and had helped to diversify Asia's economic base, suffered.

Aside from travel and tourism, amongst the first effects was a reduction in household consumption. Retail establishments were reporting a dramatic fall in foot-traffic as shoppers ventured out only to purchase necessities. Discretionary and leisure shopping were being eliminated as people in hard-hit countries avoided public gatherings, where the disease could be contracted.

Thus, the initial impact was to undermine sources of growth that are related to discretionary spending—vacations and nonessential consumption. Of greater concern was the potential of SARS to disrupt trade patterns. Economists anticipated that intra-Asian trade would suffer as a result of SARS, reality was that East–West trade only experienced a mild decline. Trade between Asian economies decreased insofar as there was a fall-off in spending on Asian-produced goods. The primary channel was the disruption to discretionary spending. Thus, to the extent that residents of, for example, Beijing, purchased fewer televisions produced in Korea, intra-Asian trade slowed appreciably.

Much in the manner where growth in US business travel permanently slowed following the disruptions that ensued after the September 11 terrorist attacks, a fair amount of business travel to Asia was permanently replaced by Internet conferencing and the like, as cost-conscious firms adapted to the new means of international exchange. Also of great concern was the effect of SARS on foreign investment in the region. Over the near term, foreign investment was delayed, but not cancelled. Manufacturers were still keen to take advantage of China's cheap labor, its admission to the WTO, and its currency peg with the US dollar. Multinational firms waited, then, for more evidence on the extent of SARS in China and other low-cost Asian countries. Some projects were delayed before firms decided to proceed with relocating to China, or were diverted to another Asian or non-Asian destination.

In 2003, the extent and longevity of the SARS outbreak was still highly uncertain. Multinational firms adopted a cautious approach before responding to the disease by shifting production locations or redirecting investment. Although the disease's impact was not permanent, and in fact there was a progressive and rapid return to normal levels of business, the short-term impact was unprecedented.

One main cause of the rapid spread of the crisis, with so many economic consequences, was globalization. Multinational companies, which are both strong and weak when they have to deal with this kind of threat, link every producer and consumer in multiple countries. They are strong because they can easily change their supply chains, and weak because they are connected with many countries, so are directly concerned by any crisis that occurs somewhere in the world.

Emerging infectious disease outbreaks have a tremendous negative economic impact on trade, travel, and tourism, but in the case of the emergence of the SARS crisis and after, despite major losses, the industry showed good capacity to adapt to this kind of threat. In addition, many sectors showed that they had learnt from the SARS case. For instance, the pharmaceutical sector understood how to take advantage of this kind of crisis. If it seemed not to be much concerned by the SARS crisis and reacted slowly, the last H1N1 crisis was instead a great economic opportunity for many

pharmaceutical companies. Criticism of the WHO and how it has created opportunities for such pharmaceutical companies coexists with praise for the WHO.

In conclusion, the industry, irrespective of its sector, now shows a good capacity to react and control the crisis, or (for some) even to take advantage of it.

SARS: an epidemic affecting multiple domains

The issues in the SARS case study fall into three aspects: (a) health of humans and animals; (b) economic effects on the market and market responses to crisis; and (c) political effects on governmental relations and their reactions. All these effects are closely linked and must to some extent be considered as a whole.

(a) *Health Aspects*: The epidemic concerned the health systems of all countries and the WHO. The first challenge is to identify the virus and the origin of the epidemic. Is the country in which the outbreak occurs able to identify the risk and notify the WHO and the other nations? What should be the reaction of the WHO? Should it wait for further confirmation or take the initiative to investigate on its own? If the country in which the crisis occurs is not forthcoming with information or has challenges in gathering and verifying information, what should the reaction of the international society be? In this situation, sovereignty can be an obstacle to solving a global crisis, yet the efficacy of a solution depends on local capacity and local approaches. So before dealing with the epidemic, international organizations have to first settle relations with other countries and achieve some level of cooperation. After the SARS crisis, numerous lessons were learnt, many of which became useful when other epidemics occurred, as in the case of H1N1. After SARS one can say that in a globalized world, an infectious disease in one country is a threat to all. Infectious diseases do not respect international borders. SARS helped the world learn that disease outbreaks can reveal weaknesses in the public health infrastructure of a country and indeed even globally. SARS also shows that even in the absence of a curative drug and a preventive vaccine, emerging infections can be contained if there is a high level of government commitment; however, it is also important to strengthen epidemiological and public health services and to beef up international and inter-country collaboration. Communication with the public, media, and other stakeholders is a key element and lesson learned from the SARS epidemic. Global partnerships to share data and information can enhance the level of preparedness and efficacy of responses to epidemics. Such sharing needs to be rapid to have the needed effects. SARS has also shown that the WHO and other international technical agencies can play a critical role in catalyzing international cooperation and support.

(b) *Economic Aspects*: The major questions relating to the economy are: what is the impact on the market? And what will be the market's response? There are three groups of economic stakeholders: producers, exporters, and consumers. They all need to know whether they must stop producing, trading, or eating chicken. There are also many shared decisions: where to stop production and how to anticipate the reaction of the public, and hence how to gauge the effects on and patterns of consumption. Ultimately, the main question relates to reorganizing production and trade systems.
(c) *Political Aspects*: The political issues revolve around the reaction of the government, in particular where the epidemic originated. The role of government must be one of regulation, supporting industry and trade, while abiding to international commitments. Should imports from affected countries be banned or could other control measures be used? If bans were imposed, what would be the reaction of the concerned country? Is there a risk of retaliation? This reaction was seen in the response to the *E. coli* outbreak in Germany, when many countries banned products from countries feared to be the source of the outbreak. Furthermore, what role could be played by international organizations, such as the WTO, and how do these roles relate to country-level decision-making and sovereignty? Finally what would be the diplomatic consequences of each state's reactions?

The economic issues usually dominate the concerns. The many actors with an economic stake sometimes push for downplaying the fear about spreading the disease. Producers want to continue producing chicken, and traders want to import, export, buy, and sell chicken. It is interesting to note that many countries banned imports of chicken meat from China, and even those that did not called for better labeling to identify the origin of products so that consumers could make their choices. Many countries weighed the possibility of prohibiting consumption of chicken altogether, but were prevented from instituting bans due to the reactions of other actors. Importers focused on the possibility of replacing imports from China. The US, UK, France, and Brazil gained from the loss of China. In general, mediation between the different actors ensures that overreaction to a crisis is avoided.

Drawing up scenarios

The SARS case could include consideration of possible scenarios: best, realistic, and worst case.

Worst-Case Scenario—International Shutdown: In a worst-case scenario, the disease could disrupt production schedules and trade, as well as inducing a crisis of confidence that could re-orient international investment patterns. The worst-case scenario, in which SARS degrades the quality of the labor

force in afflicted countries, brings manufacturing activity to a halt. This is most likely to occur in the countries where the health system is poor, and could even cause and faster transmission of the disease. In the worst-case scenario, not only would foreign direct investment (FDI) be redirected, but the country would also experience an exodus of multinational firms that utilize it as an export platform. The WHO could react too slowly in such a scenario, not providing sufficient information or guidelines for countries to implement. Diplomatic relations could break down, and the lack of cooperation could lead to closed border policies, with the result of a dramatic reduction of travel. Ultimately, the final result of the crisis could be a new status quo, as returning to the old state of affairs would no longer be possible.

Base case scenario—successful containment In the realistic case scenario, cooperation between governments, international organizations, and economic actors occurs, but with a time lag. In this realistic prototype, countries ban live chicken imports, resulting in diplomatic and trade tensions. Imports and exports of the concerned product fall. Information strategies become important regarding the safety of chicken meat cooked at high temperatures, although the presence of multiple sources of information could sometimes cause consumers to be confused. Chicken consumption plummets, but then returns to normal levels relatively quickly when international cooperation takes place. The effect of the fall in consumption is mostly felt in the countries originating the disease. In the long term, tensions might be created, but eventually cooperation can be achieved and a return to the previous status quo is possible. There is no complete breakdown of international relations nor are there significant steps towards the creation of an international framework of cooperation and reaction to a global crisis.

Best-case scenario—international crisis management The epidemic could also be successfully contained through cooperation and internationally planned responses. The WHO could play a more important role in negotiations, all member countries could implement anti-panic campaigns and substantial regulation and a containment system could evolve. Affected countries would cooperate and chicken exports would be temporarily suspended in order to avoid a major spread of the disease. In the long term, the economic and political status quo would be restored whilst resulting in a strengthened framework for international crisis management, communication, and transparency. More attention would be given to regulating health issues and providing support in developing countries, recognizing the global effects that such issues can have. Farmers in affected countries would be subject to health standards. The international community as a whole would result in improved access to information and improved capacity for joint decision-making.

To achieve a shared vision on a global scale it is necessary to have certain conditions in place. First, leadership is about building trust and identifying and communicating issues clearly (what to do with facts and how facts are confronted). Indeed, one of the leadership's roles is to define reality and to mobilize stakeholders into action. This requires commitment to work on different aspects of the crisis. A demonstration of this is a quote from Prime Minister Goh Chok Tong of Singapore in 2003 that "SARS may not kill everyone in Singapore. But it can kill the Singapore economy. Therefore, it can kill the livelihood of Singaporeans." Reputation, transparency, and accountability are all important measures to reflect one's standing in the global hierarchy. In its initial mishandling of SARS, China squandered precious political capital that it had built up over the past years, which it later regained and used in future years.

Setting priorities

The SARS phenomenon had a worldwide effect on the volume of chicken meat exports, quasi-similar to the oil shocks of the 1980s. It is important to consider as a top priority, in any shared solution, the establishment of regulations to avoid the breakdown of a whole system based on trade, cooperation, solidarity, and transparency; a system that impacts on all the individuals in their safety and quality of life. The consequences of regulatory failure can be huge.

In times of crisis, especially when there is a risk of contamination, countries tend to close their boundaries and take unilateral measures. That's why dialogue is fundamental to try to reconcile the divergent interests of the respective stakeholders.

Among the divergent interests of stakeholders are farmers who want their governments to take concrete measures to solve the problem of imports and exports, but also want the implementation of a national policy that takes into consideration the situation at a national level, for example, through the demand for subsidies for their losses.

For example, one of the Chinese government's top priorities was the circulation of the right information for safe consumption, whilst contemporaneously dealing with the effects at the industry level to ensure that exports would not be affected. They wanted to learn more about the disease in order to control it. As a corollary to such concerns the Chinese government showed a willingness to resolve conflicts of interest and to take strict control measures like ensuring inspections of the farms or establishing disease prevention campaigns. But China focused on and stressed mostly the importance of continuation of exports.

Worldwide exporters, from their side, wanted an international database to confirm that the exported chickens were safe to consume. They wanted to secure their exports; thus they were in favor of external interventions with standardization of norms. Consumers want to continue consuming chicken,

as it is cheaper than other meats, but not to the detriment of their health. In addition, they argue for the "right to know" especially seeking information about health risks. Advocacy groups were keen to suggest the creation of a vaccine. But the challenge is that poultry vaccines available may not be effective against a virus that is constantly mutating. All actors would benefit from the WHO tackling this challenge on a global scale. This requires international support to fund the WHO and to support calls to fund collaborative research.

One can distinguish a national dynamic (for example between government and farmers) and an international dynamic (for example between health organizations and governments). It is more difficult to solve situations like the SARS epidemic because of the need to coordinate what is done on the national level and what should be done on the international level.

To manage the risks at the production, export policy, and consumption levels is also critical. For example, on the health level, it implies avoiding the spread of contamination by setting up, among other things, hygiene criteria. On the economic level, controlling prices for consumers is important, because a chicken labeled as safe will be more expensive.

Some measures for a worldwide policy are: inventory of the cases; strict measures for biological security in agricultural practices (recourse of subdivisions, control of animal movements and so on); intensify collaboration between sectors of the government; use "antivirus" for national use in the beginning to protect exposed people; support comparative research to know more about the conduits of transmission and the group at risk and to find effective treatments. And that leads to the final priority, but before that it is important to stress the value of preparing an action plan in case of a worldwide pandemic (for example closing schools).

Developing the relevant data and measures is also very critical: How is SARS spreading? And how is the disease evolving? This objective needs the reinforcement of cooperation between countries at the international level (declare the cases and find solutions together). Data is essential to know what is going on and to limit the panic effect of uncertain consequences. Many scholars have argued the fact that the public health responses to SARS and also to pH1N1 were hampered by compromised decision-making as a result of a failure to understand the true nature of the events. Lack of understanding derives from over-reliance on assumptions rather than epidemiological intelligence to guide responses to threats from novel pathogens (Schabas, 2003).

Not all priorities can be tackled at once and in a short amount of time. A process of triage, classifying areas of least and high priority, is needed. Actions that can be done directly are usually accorded high priority (export bans for example), as they can be explained by the need for speed. Some of the major players could also be weak—such as the relative weakness of the WHO at the time of SARS—a fact that forces decision makers to afford them

least priority because it needs time to resolve. Co-developing shared futures through reflection and collaboration to give the organization the means for its actions could result in making strengthening the WHO the top priority. Indeed, the WHO ended up having a very important role in the SARS solution process. Existing international law on infectious disease control is archaic, formed half a century ago before mass global travel. The WHO can only issue "soft law" recommendations, rather than binding obligations. Many governments see disease prevention as an internal business; but in a globalized world, any disease is just one airplane away. That's why it is not a provincial or national issue; it's a global one. In addition (and unfortunately), the WHO lacks the authority to investigate outbreaks without an invitation. For SARS, the WHO did issue the first travel advisory in its 55-year history. The backlash over lost trade and tourism may explain some of the deference to member nations in somewhat downplaying the immediacy of the current pandemic threat. Finally, one could question whether the WHO is under-funded; is an annual core budget of $400 million sufficient to be ready for all pandemics?

In the long term, building an international health system and developing more collaboration between the WHO and the World Trade Organization (WTO) may be needed. Such a solution explicitly recognizes the interrelationship between health and economy. The financial crisis of 2008 is a good example; it appeared that the WHO did not react directly because it had insufficient background on the effects of economy on global health.

Evaluating risks involved

The major risk involved at the core of crisis management in the SARS case is that of deteriorating global public health, i.e. the risk of widespread infection and propagation of the epidemic. Such a risk focuses the attention of all the players (whether global or local stakeholders) of the private sector and of public policymakers. In fact, the interests of all parties concerned converge in instances such as SARS with regard to the necessity to join their efforts to find a scientific and medical solution to the situation. In order to have a clear picture and to assess the risks of widespread pandemics, it is essential to allow researchers and scientists to determine scientifically the nature of the virus, its origins, whether it mutates, how quickly etc. Measures of importance include the number of cases concerned, the likelihood of finding adequate treatment for infected people (such as a vaccine) and understanding of the virus' mechanisms of action on human organisms. All such measures can be used to assess the global health-related risks mentioned above.

This chapter has identified considerable divergences in view of political, economic, and reputation-related positions, corresponding to responses to real or perceived risks by the various agents involved in the crisis. For instance, any state's tendency to view crisis management as a matter of

domestic concern is particularly worrying knowing that the WHO does not have any means of enforcement of legislation at its disposal. However, in practice "unilateralism" has been successfully avoided in the face of the gravity of concerns and of the interdependence and interconnectedness prevailing in today's world; the governments of countries affected by the pandemic did cooperate to a satisfactory extent. Looking at the internal affairs of the countries at stake and analyzing their public discourse and specific health management during the crisis can best assess the latter risk of having uncooperative government behavior. A country that is not willing to cooperate will typically have a very "independence-based" discourse, emphasizing national sovereignty and principles of non-interference in a very ideological fashion. Examining diplomatic ties with international key actors, i.e. the WHO and strategic member states, and state behavior in general, also evaluates in a qualitative way the probability of non-cooperation on behalf of a member country of the WHO.

Activities such as tourism experienced a highly negative impact due to the SARS crisis. This impact was very dependent on the way the crisis was dealt with and how long it took for people's mistrust to disappear. Risk can be measured through the evolution of parameters such as trust in public authorities and their information, the quality of media information, and the image conveyed by the press, as well as the efficiency of global WHO campaigns to position the problems in rational terms. These parameters, which can be qualitatively assessed, provide insights into the dimension of risk for tourism and leisure industries, as well as for the travel industries. To assess these same risks quantitatively one may take the figures of flight tickets sold, possible cancelled flights, and profits/losses of airline companies, or evaluate the drop in governmentally provided figures relating to tourism and tourists' spending in one country.

Similarly, declines in the export of goods and products and in diverse private investments constitute economic middle and long-term risks for countries affected by the pandemic—which can be measured by comparing figures on financial investments and import/export balances published by governments or by international organizations, e.g. WTO. A possible collapse of the chicken farming and exporting industries constitute a serious risk that will orient many countries' policies as it would have a major impact on jobs and incomes, and raise political risks as well. This explains why the US and the EU temporarily blocked their imports from China to reassure and revitalize local production and consumption at the request of farmers and consumers.

All these risks depend on the way the crisis is dealt with internationally and on how information is conveyed. An important aspect is the attempt to rationalize the issue in people's minds so as to generate rational responses, which are hence predictable and easier to deal with. The amount of trust that individuals manifest toward their own authorities is a defining factor, as

seen in the drastic reduction in chicken consumption due to a lack of trust in the information provided. Social trust is in fact an important component of the phenomenon of social amplification of risk, in that distrust distorts the overall risk perceptions and amplifies risk signals. This is especially true in risk situations like health epidemics, in which people are expected to trust the scientific information they are given. Complex risk management and communication and the lack of trust distort our perception of reality and, as it is typically self-reproducing, it is much easier to entertain than trust, which can be easily lost.

Achieving outcomes

In challenges such as SARS, it is the capacity for rapid reaction in the public and private sectors to adapt to threats that makes a difference. For businesses and other interest groups, it means organizing one's self and exercising pressures on government and companies to ensure that stakeholder concerns are taken into account. This implicates trade-offs and compromises, but also the constitution of perhaps eclectic and informal alliances.

Mutuality and reciprocity are necessary principles for transparency, responsible state behavior, and accountability toward the international community. These principles turn out to be a condition for trust, which is in turn necessary for other sovereign states to take less drastic steps toward contaminated countries. So it is in the interest of any country facing a pandemic to disclose and fully cooperate, in order to gain credit. Otherwise, non-complying governments will, at least, be informally sanctioned by public opinion and consumer choices, and will eventually even suffer exclusion from international decisions. Communication is in everyone's interest. Instead of entering a phase of mutual economic "threats" or direct coercion, diplomatic relations seem to be sufficient and effective instruments.

Theory U shows us that dialogue is essential to identify convergent interests and adopt a fair consensus on the objects of negotiations at the international and national levels, and also at the level of interactions between internal public debates and international commitments.

In the situation of SARS, options were designed within a dialogue structured at various levels that advanced very quickly to deal with the crisis and that addressed, managed, and controlled the risks of policy-making, market failures, asymmetric information systems, and communication, as well as international cooperation. However, a huge part of the risks resulted directly not from the rational and objective quality of observation, but rather from highly emotive reactions, namely "perceived risks," which operate as rumors and spread in societies.

Because formerly national or regional problems are increasingly dealt with through international cooperation, different actors with unique backgrounds are forced to cooperate in order to achieve a common solution. The SARS case emphasizes co-sensing to allow a deeper understanding of each

stakeholder's concerns. By bringing in the perspectives of all stakeholders one can learn how others receive their arguments and how to define and refine their arguments. As a practical social technology, Theory U suggests that the way in which one attends to a situation determines how a situation unfolds. It therefore seems logical to reflect on one's own not necessarily impartial cultural background when working in groups. In order to handle an emerging risk it is necessary to look at an issue from different angles. *The lesson learned is that more powerful international players could learn more and become more effective if they were to listen to a broad array of stakeholders before determining a course of action.*

Tensions arise when a response seems too unrealistic for others, although it opens a window to address issues that have not been considered. Immersion in an unknown field requires leaving behind an environment that in the past has provided a sense of security (what Theory U calls "letting go" and "letting come in"). Another important issue to pay attention to is the mood of multi-stakeholder groups, which swings between highs and lows and is not always at the optimal level of energy. One needs to address these issues of motivation for energy to be restored and the work continued with high involvement. *The lesson learned is that it is important to take time to ensure different approaches, so that understanding of the problem can be sorted out before going to the solution stage, and it is important to engage as many stakeholders as possible to arrive at superior performance in terms of shared outcomes.*

Pulling it all together

As in the previous modules, it is very useful to self-evaluate. What I suggested to Serge, and which he used with the client, was very helpful for the team leaders of each stakeholder group and for Serge himself. You will find in Box 3.3 a summary of the self-assessment questions that were helpful to Serge and which can serve in assessing learning-while-doing in a similar crisis.

The first assessment relates to downloading and sensing from other members of the team, which is the first stage of Theory U. It involves starting off in areas of personal expertise and exploiting what you already know. Negotiation while sensing what other stakeholders may want is also an important skill. Shared accountability that comes from ensuring that all have a role and agreement on the final approach helps to ensure success in implementation. Keeping track of what worked in the process of reaching agreement and the steps followed helps the learner hone this skill over time. The approach is also aimed at getting to a final agreement with as much efficiency as possible (Code A from Chapter 2).

The second set of questions revolves around thinking outside the box and seeking innovations. It is important to take note of the actions, instances, or triggers that led you to think outside the box (Code B from Chapter 2). Negotiation can be very useful to explore what you don't know.

Empathizing with other stakeholders can help you become more effective in anticipating follow-up demands during a negotiation. Listening carefully and trying to see things from their perspective is also very helpful in shaping areas where you can be flexible and where you have to fight to ensure that your perspective or preference makes it to the final agreement. New information garnered from co-sensing a solution with a wide range of stakeholders could also result in a shift in your behavior and introduce areas of new flexibility. Tracking where you evolved and became more flexible helps you learn when next to use such a strategy. Sometimes detail can come in the way of a attaining a grand bargain and it is important to note when this happens and to ensure that a process is used that allows you to get out of the weeds. Encouraging open and structured interventions is a good way to get out of narrow perspectives, but you sometimes need to pay attention to the big picture or common objective in order to avoid being bogged down by details that may derail from a shared final agreement (Box 3.3).

Box 3.3 Evaluation Block III: Self-Assessment Tool for Seeing and Sensing

Did you focus negotiation on your personal area of expertise?	Code A
How did you exploit what you already know?	Code A
Were you able to meet needs of your negotiating partners?	Code A
How did you ensure accountability for the final agreement?	Code A
What steps did you follow to improve the final agreement?	Code A
What steps did you follow to improve negotiation process?	Code A
What forced you to think outside your preliminary position?	Code B
How did you use negotiation to explore what you didn't know?	Code B
Could you anticipate follow-up demands of negotiators?	Code B
How did you allow other ideas to emerge?	Code B
Where did you have flexibility?	Code B
How did your areas of flexibility evolve?	Code B
How did you avoid getting bogged-down (detail, process)?	Code B
Did you encourage open and unstructured interventions?	Code B

The role of learning during a crisis cannot be underestimated. Reflecting with Serge on what worked best at the end of the engagement some months later, we learned that the process of asking each individual participant to write a report on the group work, developing the perspective of their stakeholder group further using other sources of information from outside the group work session, was invaluable. Each participant included a short observation note on the process employed in the group work to come collectively to a common strategy within the primary stakeholder group and during the multi-stakeholder dialog, as well as on the lessons learned from the sharing

at the plenary sessions. These reflections have become tremendous learning opportunities and I have used them in subsequent classes and for client work in similar situations. Such a process replicates what happens in a real crisis, as shown by Bennett et al. (2011) in their study of how information is spread at the community level and the effect the behavior and opinions of peers have on public reactions to crisis. This form of social learning is critical when managing crises. The ability to track and disseminate information faster using social media presents capabilities that can render the reaction to crisis more effective in the future.[14]