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Is There a Way Out?

Ut desint vires, tamen est laudanda voluntas. (Even when the forces are lacking, one must still praise the will.) (A Roman saying)

Introduction

In thinking about ways out of the current sustainability conundrum, we need to acknowledge that there are information-processing dynamics, such as the dominance of past tools for thought and action and the shift in focus toward shorter-term tactical solutions (rather than longer-term strategic ones), under the impact of unintended consequences that have brought us to this point because they are fundamental to human behavior, and therefore difficult to ignore. They have been discussed in Chapters 5 and 16 as major factors behind the path-dependent trajectories of all cultures and worldviews of individuals, groups, and societies. Changing these path-dependent trajectories and their current instantiations is well-nigh impossible in the absence of a set of external values and norms against which we can leverage them. Rather than try to change the values that underpin the current socionatural system in the western world, which are anchored so deeply and have been in existence for such a long time, it might be better to try and redirect them. Instead of initiating change by trying to frontally attack mindsets or worldviews that are closely related to people's and groups' identities, I think we would do better to focus on changing behaviors in the broadest sense; not limiting change to such things as "fly less, save energy," but rethinking all aspects of our behaviors, institutions, and investments from a practical point of view.

How do we change relevant behavior patterns? First of all, it seems that as we have collectively dug ourselves into a huge hole, we have to stop digging. In a literal sense, this effectively means finding ways to redirect the current extraction-to-waste socioeconomic system in time for us to conserve at least part of the Earth's resources and the cultural diversity that humans have built up over many millennia. A crucial part of this is that we must slow down the innovation revolution that is so closely tied to the plentiful availability of energy worldwide, and in particular its information and communications technology (ICT) component, which risks, as we have seen, creating a profound disconnect between the technical developments involved and the societal dynamics to deal with them, as it will result in an acceleration in the emergence of unanticipated and unintended consequences for all aspects of our society. We must thus change behavior simultaneously on a wide range of scales and fronts. In the next few pages, I will look at some of these behavior changes bottom up, from the individual to the group, society, nations, and finally the globe as a whole.

Individuals must Reengage in the Management of our Society

Overall, democratic governance and participation in it seem to be increasing, as new nations open up to it.[1] Yet in a number of developed and developing nations there is a trend toward reduced active participation of the wider population in governance. In developed societies this has recently (since about 1980) manifested itself in the fact that an ever-smaller percentage of the population participates in national elections, and an even lower proportion of people in local, regional, or (in the European case) European elections.[2] This is interpreted as the result of people losing the belief that participation will actually change anything in their everyday lives. In developing nations, but also in some developed ones, the lack of participation may also be the intended result of an absence of freedom of speech, press, and meeting, enforced to varying degrees but generally structured to maintain existing power structures. In other countries, the culture of individual expression on political topics is less widespread, so that voting is not a good barometer of the extent of participation in governance.

Whatever the causes, non-participation in elections has one major effect – people who do not vote are relinquishing control of their destinies. Many of them lead a relatively comfortable life and have not known anything else. They assume that this will more or less continue, and that governance is in the hands of a relatively small group of people who have

a solid grip on it. Others think that the people in charge will never improve their lives, and ignore elections because of that.

By not exercising greater control over decision-making in our societies, many of us in the developed countries have, almost imperceptibly, handed such control over to very small groups of people and institutions: large businesses, government bureaucracies, and elected representatives at all levels, from our village or town to our national government. Democratic structures that began as a way to enable a society to achieve necessary and important, societally accepted, goals by according large numbers of people (ideally everyone) a vote in societal decisions, are being transformed into a way in which small minorities can gain control over what happens in the society and bend it to their own advantage. Enabling power has turned into controlling power. Only a few small developed nations such as Switzerland and Sweden have so far escaped this trend.

In this context, I am often reminded of a phrase of Archbishop Desmond Tutu of South Africa: "When white missionaries came to Africa, they brought the bible and we had the land. They said: "let us pray." So we closed our eyes and prayed … and when we opened our eyes, we had the bible and they had the land …" (Retrieved August 5, 2017 from: www.brainyquote.com/quotes/quotes/d/desmondtut107531.html)

But elections are only part of the story. If we are to redirect collective behavior in our societies, our starting point should be to reinvest ourselves in the sociopolitical and economic dynamics of our own immediate environments by spending time to familiarize ourselves with the issues and the options facing us and exercise not only our right to vote, but also to actively participate in the management of our communities and environments. If we are to stop digging the hole in which we find ourselves we have to plan a different future – by first asking a question about the kind of future we actually want as a think-outside-the-box-challenge, and then designing a roadmap that may get us there. This needs to be done locally, regionally, and nationally as well as globally. An interesting example of how to organize this is developed by Saijo (2017) and colleagues of Kochi University of Technology for the Japanese towns of Yahaba (Iwate prefecture) and Matsumoto (Nagano prefecture), as well as in both urban (Dhaka) and rural environments in Bangladesh.

Designing a Plausible and Desirable Future

Calling for innovation is not enough if we do not first consider where such innovation should lead us. After all, we must regularly remind

ourselves that the last 250 years of unbridled innovation in every direction have led to our supply-driven materialist and consumerist innovation culture and to our current sustainability challenges. If we want to do better, we must also learn to better understand and steer invention and innovation. It may be worth repeating here that we hardly know enough about the dynamics that drive the processes of invention and innovation, mainly because these have to do with the emergence of new ideas (objects, routines, institutions), and emergence is not very easy to study in our traditional reductionist, ex post scientific approach that focuses on providing and proving explanations of currently observed phenomena, and thus inevitably links their present with their past (learning from the past) by means of a cause-and-effect narrative. As a result, we know quite a bit about the conditions under which inventions and innovations flourish and the ways in which they affect the economy, but have much less scientific, procedural knowledge about invention in particular that could help us focus or steer invention and innovation effectively. We must among other things come to understand how invention and innovation dynamics work, and how they affect outcomes. I point to some ideas that might promote such understanding in Chapters 12 and 13.

But more generally, we have to develop ways to promote thinking constructively about the future. One way to do this is by developing the academic discipline of Future Studies. Currently, the development of models, scenarios, and forecasts is widespread among major corporations, governments, and supragovernmental institutions. But there is no independent academic community of a reasonable size that can critically look at the results of such exercises and help develop such efforts. To cite Alan AtKisson: ""Future studies" seems to me a kind of academic ghetto, marginalized from mainstream sustainability studies (and even farther removed from mainstream politics and economics)! (personal communication January 8, 2018)."

Repeating the gist of Chapter 6, if we are to plan our future we must adopt an ex ante perspective, linking learning from the past to learning about the present and to learning for the future. We should more directly focus on the processes that generate new phenomena, on the emergence of phenomena rather than on explaining existing ones.

A major barrier to asking about the kind of future we want seems to be that we often view our current predicament as the result of a quasi-inevitable evolution toward progress. This is a very deep and ancient

tradition in our western cultures, but it is also a needless and distorting simplification of the reality of our history. On the contrary, at many times in our history there have been moments in which our societies' trajectory was determined by choice (in the sense of systemic choice) involving the actions of an individual or a small group of individuals. Choice is important, whether systemic, local, or individual!

The situation in Europe in around 1750–1850 which I referred to in Chapter 12 is a case in point. Revolutions (France), near-revolutions (Germany), and war (Europe and North America) show that the structure of European society at the time was approaching a tipping point. Major structural changes occurred as a result of these events, but in particular the harnessing of fossil energy by means of the steam engine and the reorganization of Europe's colonial empires from trade empires to production and marketing empires gave European societies a new lease of life. That said, things could have gone a different way, and European societies could have disintegrated. Choice is important, whether systemic, local or individual. The lesson is that if we are, as we think, at a similar point in our history, facing a tipping point, we must not succumb to an incremental (or worse a passive) perspective, but we must actively stimulate choice by collectively thinking about the kind of future we want, while being fully aware that unanticipated and unintended consequences of past systemic decisions may also limit the extent to which we can influence the future.

A fundamental question at this point is whether we actually struggle to achieve a chosen (more or less distant) ideal, or whether we accept that the future is ontologically uncertain and cannot be determined, so that our main efforts should be to optimize the path that we follow in our everyday actions, choices, and relationships. This dilemma is in some ways reflected in the difference between our western (European/American) approach and the traditional Asian approach to life (Puett & Gross-Loh 2016). Investigating that difference, as is done brilliantly by these authors, highlights a wide range of other differences that one may need to consider, of which in my opinion the most important one is between the western focus on entities (objects, individuals) versus the traditional eastern focus on patterns, relationships, and, in an abstract sense, systems. Do we strive for individual success, in competition, or do we strive for the success of the community? What is success: behaving like an ideal person, as is the case in the Judeo-Christian and Muslim tradition, or behaving like "ordinary" human beings with all their idiosyncrasies?[3] Do we strive for the realization of our individual potential or for that of

the group? Ultimately these questions touch on the puzzling question of the existence and role of free will. How independent are individuals and their thoughts and actions from their context? Is the context, and are our relationships with our surroundings (including our social networks), dominant in determining our behavior, or are we as individuals? From the complex systems perspective, contexts and relationships seem to shape decisions and actions to an important extent, but what the role is of individual and collective desires in that process is still an open question. Are such desires fully shaped by contexts and networks, or is there a (genetically or otherwise determined) individual factor that plays a role in them? These are the kinds of questions we need to raise, discuss, and form opinions about as part of our efforts to outline our future actions.

From my perspective, one of the major thrusts should be to strive for an increased multidimensionality of our individual and collective value spaces. I outlined in Chapters 17 and 18 that in my opinion the relative reduction of our value space, individually, nationally, and globally to fewer and fewer dimensions, dominated by the lowest common denominator of wealth, has been a major contributor to the increasing wealth discrepancy we observe in the current world, but also to the destruction of many local, regional, and national social networks, thereby undermining the strength and resilience of communities worldwide, resulting in the urbanization and individuation of our societies. This has in turn facilitated the emergence of growing power over societies on the part of small elites. In the next couple of sections, I will discuss this process in some more detail.

The reduction in the dimensionality of our human experience in the West is also driven by another powerful, and relatively underinvestigated, set of drivers – individual and societal emotional desires. Over the last century, with roots in the works of Freud and his colleagues in different branches of psychiatry, motivational research in advertising has slowly but surely accorded desires a much larger place in human decision-making (see the classic work of Packard 1957). In the last twenty or so years, this has again led to a major development in the scientific study of the role of human desires in decision-making in general, with certain authors according desires a more important role than any kind of scientific or other rational reasoning. It would take me too far from the main subject at hand to summarize this literature, but in the next section I will outline how one might see desires at work in creating narratives that drive our decisions as individuals and societies.

The Role of Narratives

Narratives and memes have in recent years been recognized as important potential agents of change. They can serve multiple functions, some of which are tied to the identity of people or groups. They have been seen to help anchor culture and society around certain basic ideas, myths, or defining moments in history. But it is interesting, in the present context, to drill down into the underlying dynamics.

To that effect, I am adopting the thesis that, in a process of increasing focus on the future in European (and later other western) societies (Girard 1990), our visions of the future have slowly but surely become a major structuring factor in our behavior and decision-making. This process has been going on since the mid-eighteenth century and coincides with the beginnings of the "Great Acceleration."

Beckert (2017) argues that the underlying difference between our current western conception of the future, and that of pre-1750 days is that in medieval and Renaissance times the future was conceived as more of the same, whereas since then it is increasingly viewed as open – subject to uncertainty and unpredictable change. He argues that this has set in motion a (uniquely western) cognitive feedforward loop that creates in our minds "imagined futures" and then develops "fictional expectations" that motivate people toward realizing them. In his words, "expectations of the unforeseeable future inhabit the mind not as foreknowledge but as contingent imaginaries" (Beckert 2017, 9); "they create a world of their own into which actors can (and do) project themselves" (Beckert 2017, 10).

Of course, these fictional expectations are continually adapted to present circumstances. For Beckert, this exchange between imagined futures and present conditions drives our decision-making. "Fictionality, far from being a lamentable but inconsequential moment of the future's fundamental uncertainty, is a constitutive element of capitalist dynamics, including economic crises" (Beckert 2017, 12). He illustrates that in detail for the four main pillars of any economy: money, credit, investments, and innovation.

The implications of the role of such imagined narrative futures stretch far beyond the economy. First, they imply that the cultural, institutional, and social embeddedness of decision-making is based on imagined futures. Decisions reflect the value systems of the people concerned; they are shaped in the interaction networks of these people. Much of our current thinking about the future, for example, is in essence based on a western imagined future that, as part of globalization, has been projected

onto other cultures. In other parts of the world, one finds underneath that global projection very different imagined futures. Part of our task is to identify some of these, particularly in parts of the world that might replace the current western-dominated political system.

Secondly, imagined futures are constructed by comparing the present to an imagined future, and they are maintained only as long as there is confidence in that future. In the absence of such confidence, a degradation of people's circumstances or a crisis is experienced. The anticipatory loop can then very rapidly be turned in a negative direction, toward uncertainty, as in the case of recent financial crises. But that is not confined to such crises – it can slowly undermine the totality of our confidence in the future and result in hesitations, contradictory actions, and general loss of self-confidence.

Thirdly, our concern with sustainability can also be seen as the construction of an imagined tipping point for our world. By implication, the current imagined future that drives our present global socioeconomic and environmental system is less solidly anchored and stable than many people currently expect, and in projecting futures for the world we need to take this into account.

Fourthly, we need to consider the relationship between our imagined futures and the real world out there. That interaction is clearly an open-ended one that is not fully controllable, subject as it is to "ontological uncertainty" (Lane & Maxfield 2005). As the imagined futures are confronted with the material and social "real" world, it is impossible to predict the outcome of such confrontations, especially over the longer term, owing to changes in the second order dynamics of the context in which shorter-term decisions are made. That confrontation is a major element in any process of invention and innovation (Lane & Maxfield 2005, 15).

To conclude this section, we need to remember that the driving force of many desires, whether sexual, esthetic, intellectual, or emotional, is a strong and permanent challenge to our current economic, wealth-based, logic. While currently this dominates and is a major factor in globalization, one can envisage a future in which individual and societal desires, as expressed in different cultures, will gain in importance and contribute to the fragmentation of our world.

Reconstructing Communities

Back to the role of information processing. I argued in Chapter 18 that the global and rapid transformation in information processing is further

weakening our existing central processing structures and institutions by strengthening horizontal communications worldwide. This clearly has important consequences for our current societal structures and the values that they hold, as it weakens the top-down element in the already fragile equilibrium between people, their institutions, and their governments, as well as the distinction between signal and noise that is dependent on the value space of a group or society.

It does not seem to me that a new social structure can emerge entirely top-down from this weakened power structure. Around the climate change discussions, we have seen that nation-states have major difficulties aligning themselves with a set of goals, and that any attempts to do so cause major friction within and among them. Although idealists have argued for many kinds of international governance, this has remained a very elusive goal; witness the difficulties the European Union (EU) has had to set up and maintain such a governance structure, and the difficulties that the United Nations has in striving to become a strong political player. As we see in Chapter 18, the novel impact of ICT is only making it more difficult to come to some kind of overarching goal in this domain.

I conclude that any fundamental restructuration will be shaped by the intrinsic properties of the complex adaptive system involved. Such a (re)structuration takes time, in the case of the Roman Empire some eight centuries or more. But that is no reason not to think about that process, as we do not currently have a choice. From the perspective of this book, it seems that for a time we will slide further and further into a phase of chaos, but ultimately this phase will generate a new form of societal organization, new values, and new tools for thought and action. Moreover, the ICT revolution may actually help us achieve such reorganization much more rapidly than in the Roman case (see Chapter 20).

How to go about such a restructuration is difficult to outline in a situation in which the ICT revolution is only beginning and is likely to rapidly change. But there are some elements that seem crucial, and the first signs of them are on the way.

One possible trajectory is that of community (re)creation based on the (re)activation of multidimensional value spaces. One example is presented by the transition towns movement that started in the UK. Focused on reducing greenhouse gases, and in the absence of sufficient progress at national level, many towns are taking their own grassroots initiatives, based on collaborations among and between one or more sectors of civil society: local government, business, non-governmental organizations, or less structured groups of citizens. Initiated in Totnes in 2006, in

September 2013 there were 462 officially registered transition settlements in the UK, Ireland, Canada, Australia, New Zealand, the USA , Italy, and Chile. In the USA, transition initiatives have been started in many communities. Their stated national aim is "that every community in the United States will have engaged its collective creativity to unleash an extraordinary and historic transition to a future beyond fossil fuels; a future that is more vibrant, abundant and resilient; one that is ultimately preferable to the present."[4]

Networks established between the transition towns are a resource and catalyst for building resilient communities that are able to withstand severe energy, climate, or economic shocks while creating a better quality of life in the process. They are accomplishing this mission by inspiring, encouraging, supporting, networking, and training individuals and their communities as they consider, adopt, adapt, and implement the transition approach to community empowerment and change, focusing on reducing and cleaning energy use, transportation, food, waste and recycling, economics, and psychology (Hopkins 2008, 2011, 2013).

This kind of community-building activity is also beginning to spread to rural areas. In developed countries, this trend is notably expressed through the organic agriculture and horticulture movements. In China, I am following a related effort in the village of ShiShou in Hubei province, and in Japan I have been able to observe efforts to revitalize rural communities in various parts of the country that have suffered from rural depopulation. Often these efforts are initiated by individuals who have managed successful careers in towns, but want to live in a rural environment and give back to the community of their youth. In Europe, I am involved in studying the efforts of a small community in the Venice lagoon to attain the same, against very heavy odds, in a largely globalized semi-urban society.[5]

Another aspect of the erosion of societal resilience is that such resilience is in large measure derived from the codependency of individuals in groups. Over the last fifty years, many risks that kept people together as communities have been shifted to the level of the city, the province, or the nation, and in some cases the EU – for example, social security, health care, education, and infrastructure. This has helped many people to climb the social ladder but it has also eroded the codependency of people in communities. The real question is therefore how we find a balance. And in order to do that, I think we must have individuals and communities regain a sense of their own risks and how to cope with them.

Rebuilding communities, and in larger cities socially rebuilding neighborhoods, is absolutely fundamental to any effort to deal with the

combined impact of the ICT revolution and the closure of our value space on the resilience of our communities, and thus on our overall sustainability. However much the ICT revolution facilitates making contact with everyone, the combined effect of globalization and commodification over the past few decades has so heavily eroded the trust and alignment on specific sets of values in each community that this trust and alignment need to be rebuilt, and this needs to be done face to face and will take considerable amounts of time (see Friedman 2016, chapter 12, for an example in Minnesota). The reopening of our individual and group value spaces that it engenders is fundamental to a successful emergence from our current sustainability challenges.

I also conclude from these examples – and the many others that I could have adduced – that we must as scientists be more humble and shed any pretense of being able to steer the future or innovate to make it happen in one specific way or another. Except in very rare circumstances, such as the Manhattan Project, no scientist of any kind can successfully try to change the world or the transformational trajectory it is on. This is a dangerous, outdated illusion that derives from our linear perspective on science, and is incompatible with a complex systems vision of society. Society changes itself. Scientists can contribute two kinds of things. First, they can tinker experimentally in the margins of the major societal dynamics, and secondly (and maybe more usefully) they can try and alert our societies to the kinds of changes that are coming, so that people can begin to prepare themselves for these changes.

The Future Role and Management of Cities

Cities are a special case, and merit some additional discussion. Their characteristic that concerns us here is the relationship between the communities living in them and the infrastructure in which they are living. The relatively long-term infrastructure in which urban dwellers live in many places complicates making changes to their social and information-processing configuration, and slows them down. This explains why urbanization so far has been the most persistent societal dynamic known to mankind. Individual cities have disappeared, but urbanization as a phenomenon has not disappeared. The fundamental drivers – aggregation and innovation – have remained intact throughout the last 6,000 or 7,000 years.

However, currently the energy–information balance that is at the root of the recent explosion in urbanization has been changing. Energy is

becoming rather more expensive than it has been for the last couple of centuries, and information processing is becoming much less expensive, and less location-dependent. Hence one important question is whether the dynamic that drives urbanization – getting more people closer together so that information processing becomes easier at the cost of increasing the need for energy – is actually going to continue. Might the ICT revolution actually offer an opportunity to change an urban dynamic that has led to poverty, crime, and other undesired consequences of aggregating such a large number of people in limited space? Or would the spread of alternative, renewable energies in the longer run reduce the price of energy again? And if so, would that promote the regrowth of urban centers in the presence of the information-processing facilities now available?

Cities are growing faster and faster, and so are innovation and wealth differentials. Members of our communities and societies have increasing difficulties in keeping up with technological change. This means that societal risks have increased. Owing to the concentration of the population one finds there, this phenomenon is particularly important in cities. Hence, I would argue that cities are in the current context very vulnerable systems. They have a very costly infrastructure, they are dependent on a very large footprint, and in view of the dynamics I have just mentioned they are no longer necessarily the most persistent social dynamic that we have known.

Most of the predictions about urbanization, and in particular that we will have about 80 percent of people living in urban situations by 2100, are based on a linear extrapolation of the current dynamics, including political trend analyses. But in the case of urbanization we are actually dealing with a complex system that has many unintended consequences, and such a linear scenario will not necessarily come about. The ICT revolution, which is only beginning and will change the world much more dramatically than anything we have seen before, undermines the need for spatial concentration in innovation and therefore undermines the need to actually build cities. Climate change will exert pressure to increase transport costs and to reduce the use of bulk transportation, so that we may have to develop economies that are more regional, more local. The food/water/energy nexus, I would argue, may well hit us long before the heaviest impact of climate change (Roberts 2009).

Together, these dynamics may constrain the business-as-usual scenario for urban development. ICT may shift the dynamic toward dispersed settlement when information exchange no longer requires proximity. This saves energy and improves resilience because it keeps mutually dependent

social groups together that are therefore more resilient. Mega-cities, as a result, may lose some of their predominance, and this will lead to an adjustment of national rank–size curves under globalization. Individual cities may gain in autonomy because the very large national and supranational units of governance may become more and more difficult to manage. But cities must find effective ways to manage focused change and stability, forcing them to invent novel ways to solve social challenges. But what these are, and how they are implemented, will differ from case to case and cannot in any way be predicted.

Innovation, as it is currently practiced, is putting our societies at risk because of the acceleration that process is undergoing. As mentioned in Chapter 2, when politicians and other people talk about innovating our way out of the sustainability conundrum, I respond that the last two-and-a-half centuries of undirected innovation in every domain of our lives has actually been a major cause of our present predicament. If we want to deal with the problem, we need to rethink the mechanisms that both foster innovation and suppress it. In that process, (mega-)cities, rather than designing change when they think it is necessary, will need to start designing for permanent change so as to accommodate the increased speeds with which urban communities change.

They will have to start integrating top-down and bottom-up codesign. What does that mean for urban architecture? In Haarlemmermeer, a little town just south of Amsterdam in the Netherlands, the Delta Development Group has been implementing the circular economy in buildings.[6] Every building is designed for disassembly and reassembly whenever that may be needed. The "owner" (in actual fact the user, rather than the owner) of the building rents the building materials, and when they are no longer needed he gives them back to their owners. By that point, these materials will have become scarcer and pricier so that the owners of the materials make a profit. Everything is either composted or recycled back into industry. Of course, this requires new business models for architects, builders, and building users, and a new legal, contractual, and possibly institutional framework. But I think this is nevertheless one of the ways forward that we need to start exploring much more effectively.

What about urban planning? In general, action is taken too late owing to slow, multilevel bureaucratic decision-making. Existing and well-known political systems are the standard and determine how we plan the future. People inside the system often become immune to signals from the outside, so that these systems tend to reproduce themselves and become more robust owing to external threats. As a result, urban

planning takes longer than the dynamics that are inspiring it, and the actual results of the planning last even longer. To adapt to newly emerging challenges, we have to look further forward in planning, with a horizon of thirty, forty, or even fifty years, and we have to find faster ways to adapt cities.

Swarm Planning, developed by a Dutch urban planner working in Australia, Rob Roggema, might offer a tool to achieve this. Roggema (2013) argues that two things are essential for planning: the spatial characteristics of the area and region concerned, and the availability of extraordinary ideas. When there is a large group of individual elements – people, buildings, connections, high-quality relationships in a network – and enough diversity, one may be able to design several coexisting patterns and coexisting ideas for further development, in which small groups of people will engender creative jumps, and new structures and information will evolve. But rather than focus on one future, multiple scenarios are prepared and multiple pathways are put in place, so that when the city is faced with the need for change, it actually can and does implement such changes much more quickly, much as a swarm of birds can very suddenly change direction based on almost invisible signals.

Dealing with the Acceleration in Information Processing

In this section I want to move from the national level to that of human societies in general, crossing all levels from the individual to the national. A directly ICT-related societal planetary boundary is that of differences within and among societies in the speed of information processing. In Chapter 16 I cited Friedman's idea that ICT technology revolutions occur every five years or so, while societies need between ten and fifteen years to adapt to them. I now want to look at this in more detail to improve our understanding of what it actually means.

I think we need to distinguish between two aspects of this general statement. The first is the fact that the increasingly smaller community that is involved in generating the technical revolutions in ICT is indeed learning and inventing very fast, thus distancing itself increasingly from the wider population. Under current financial and legal circumstances, this contributes to the wealth gap because information is power, is wealth, and there is a substantive lag in enabling others in the population to catch up in information-processing capacity because that involves transfer of knowledge and education, which both need to be organized. The second aspect is that as part of the innovation concerned, our societies have to

adapt in the widest sense, changing their behavior, their customs, their policies, and their institutions, and that takes a lot of time because it involves aligning large numbers of people around changes in the value space of which they are part.

Before I try to point to some ways to deal with this growing gap, I'd like to point out that many, if not most, people – whether politicians, business people, or citizens – assume that the ICT revolution must run its course. That is, again, assuming that history is an inevitability that is beyond human control or interference. Throughout this book I have tried to point out that this is not necessarily true – that individual or collective decisions do indeed impact on events and history in many, sometimes decisive, ways. In Chapter 16, I used the arguments of Polanyi and his students to make the point that the "invisible hand" of the market was not inevitable, but was created by the governing institutions of the time; and that when left to proceed on its own, it ultimately leads to societal reactions that can foster protectionism, trade (and possibly other) wars, and the like.

What could we do about the growing information gap? As is often the case, the opportunity to deal with this is also offered by the ICT revolution. In Chapter 18, we see that human mastery in processing information has only just set in motion a major revolution in our social, economic, and environmental organization. We should profit from that unique occasion to transform our society into one that aims for profound and accelerated restructuring. This implies that we need to collectively take a hold of the directions in which the ICT revolution may transform our society. At the moment, this is not the case – the private ICT companies are leading the development, and steering society in ways that are profitable to them. Part of such a reorientation can be achieved through the democratic process, by strengthening the constraints imposed on the companies involved, but much more can be achieved when individuals take responsibility for their own actions, strengthen their communities, and actively strive to focus on common values and goals.[7]

To begin with, we could – and should – slow down current development so that its speed is more closely in tune with what society can deal with. Here is a clear role for government. The current policy to let these developments accelerate is the result of the Red Queen race inherent in the feedback loop between the growth of the aggregates of population, notably in cities, and the need to develop new values in order to integrate them. But this feedback loop is not inevitable – downscaling population aggregates by devolving societal coherence into a multipolar world might well have the desired effect.

On the other hand, we could coherently and structurally improve the integration between general human and electronic information processing, so that most humans are back in control of the overall information-processing system. That is the essence of the book *Whiplash* by Ito and Howe (2016) that I will discuss in the next chapter.[8] This is clearly a process that is ongoing, in which exploiting the capacity of ICT to reach out and create horizontal networks of information processing worldwide can become of major importance to drastically improve the total information-processing capacity of our societies. But to achieve that, we have to direct the restructuring of our societies' information-processing capabilities in a different direction from the current one.

One measure that could in my opinion contribute to accelerating such a restructuring is the introduction of computational thinking everywhere in society by deploying major efforts in education in this domain at all school levels and ages, coupled with the introduction of generalized information society thinking in computer science. As part of that effort, we could be developing the generative (ex ante) approach to science that we think is essential, including in the historical sciences.

Another important contribution would be to replace the existing top-down and bottom-up information architectures with a more interactive approach, including improving continuous real-time communication and reducing response times.

Thirdly, ICT could be developed to enable us to overcome human cognitive limitations and biases. First and foremost, collectively we could try to overcome the limitations of the human short-term working memory. To this effect, we would need to develop more intensive sharing of human mental capabilities by continuing to invent better tools to communicate and work together as humans, but also make widespread use of electronic information-processing tools. As part of this, we would have to develop new ontologies and the software to apply them. In the scientific domain that would entail such things as developing improved transdisciplinary databases, tools for "Synthesis 2.0" (new software that allows larger groups in different locations to work together in real-time based on multi-site mirroring of content), serious, focused games to understand tacit knowledge, improved tools to study decision-making under uncertainty, open-science platforms involving people with non-academic backgrounds by crowd-solving, as well as more and better virtual experiments, in particular when studying societal phenomena. These should be based on much larger samples of data, enabled by high

performance computing and "big data" processing, which must be ana-lyzed in the greatest detail.

Our societies should also use the potential of new ICT developments to overcome the limitations of our thinking habits more widely, for example by further developing problem-based, change-focused tools that favor dynamic understanding over static knowledge. This would greatly con-tribute to the ability to overcome the current cultural and scientific emphasis on linking present and past in order to explain the present, rather than thinking about the future. To achieve this, emphasizing in education as well as in action the ex ante perspective alongside the ex post perspective that is currently dominant is essential, striving to learn from the past about the present, but with an emphasis on learning for the future. This could be initiated at kindergarten level and maintained throughout the whole curriculum, emphasizing the fact that there are always choices (and that such choices have both beneficial and potentially negative consequences), instead of presenting young children with "truths" in the form of cause-and-consequence narratives. So-called ser-ious games may be a major asset to achieve this goal, as they stimulate such ex ante thinking.

But developing such an approach will also require new thinking about the role of computing. Currently, many approaches using the big data revolution are still based on statistics, and therefore on a reductionist approach to distilling information from data, studying past trajectories and present situations. Some such approaches are discovering thus far unobserved patterns and using them to extrapolate toward the immediate future. But if we want to think about the future out of the box, ICT could be developed to move from a limited number of observed dimensions to generate as many other potential dimensions as possible, and then test those out for feasibility by combining forecasting and backcasting. This would in effect contradict Occam's razor by making the assumption that the world is complex and that, therefore, ideas need to embrace that complexity rather than simplify it away. The first, small, steps in this direction are being set by people such as Belnap (e.g., 2003, 2005, 2007) and Fontana (2012). Another interesting move toward such an approach is presented in the AlphaGo approach developed by René Coulom (Coulom 2006, cited in Ito & Howe 2017) that is able to deal with challenges in very high numbers of dimensions, based on machine learning and statistical sampling tech-niques (the so-called Monte Carlo Tree Search algorithms).

Such efforts could also reduce, and on occasion overcome, the underdetermination of ideas by observations (see Chapter 16). Massive

ICT-based data gathering is an essential step to achieve this, and more will no doubt develop in this field, in particular as sensors rapidly become cheaper and spread to many more domains.

Identifying better ways to deal with the disciplinary and sectoral biases of human decision-making toward theories, ideas, and behavior that are principally based on successful past responses is another major ingredient of such an improved approach. Any such efforts create major challenges for the integration of different kinds of data into the necessary major databases.

But above all, we scientists should organize ourselves as socially and politically engaged individuals to influence, and where necessary control, the direction in which the ICT revolution leads us if we want to avoid a future such as I will try to sketch in Chapter 20, on the basis of the work of Dirk Helbing.

Our Role as Scientists in the Community

Over the past century or so, in some of our western societies science has to some extent lost the most precious gift of all, the trust of the population – without realizing it – owing to the unchecked instrumentation of science by industry and government for purposes of innovation and/or governance. In this process, science was a willing partner and became increasingly dependent on both for funding. In certain regions and certain domains, therefore, science and scientists are either seen as too distant from the concerns of civil society or too much under the influence (if not control) of government and industry – defending interests that are not those of the wider population. The loss of appreciation for, and trust in, science shows in some countries (such as the USA and, to a lesser degree, the UK and European countries) as a reduction in funding for basic science and/or acceptance of scientific ideas. The recent push of the Trump government in the USA to seriously reduce federal funding for research shows that this distrust has reached such proportions that even a government that has thus far used and promoted the role of scientists now bends to the popular view that science, and especially social science, is suspect.

As a result of that development, as I argued in Chapter 3, we must review the relationship between science and society, make it more open and transparent, be more realistic in the expectations we raise, and be more aware of the potential unintended consequences of our actions. We must listen more, think more broadly in terms of alternatives rather

than narrow causal explanations, and use what remains of society's trust in science to influence the political debate, as well as rebuild that trust where it has been eroded.

A first essential ingredient in this context is the wider spread of the complex adaptive systems approach and the thinking behind it. The second is humbleness among scientists about their role in determining the directions our society will take. I will deal with each of these in turn.

In Chapter 7, I outlined some of the differences between the complex adaptive systems (CAS) approach and the traditional, linear, scientific cause-and-effect approach, and I have argued the scientific need to think in CAS terms. There are, however, some political and social aspects of that approach which are important in the current context, but which I did not emphasize in that chapter. A major one is that admitting the nonlinear dynamics of most socioenvironmental and economic phenomena, and their ensuing unpredictability, helps reset our position as scientists in the world. It moves us away from projecting ourselves as "experts" who have "solutions" (which in many cases have not worked or have had unintended consequences, and thus have contributed to the loss of trust in science) to admitting that there is much that we do not know. This would also help us think in more appropriate terms about a future that we are not able to anticipate, but in which we can contribute to the many experiments that finding our way as societies will require. Thirdly, it seems to me that the CAS approach contributes to a convergence between the natural and the social sciences because it reintroduces irreversibility and history in the conceptualizations of the former. Both these conceptual tools have always remained integral parts of thinking in the life and social sciences, but have for a considerable time not been part of the (Newtonian) natural science toolkit that is still widespread in science thinking. An interesting fourth aspect to this is the hypothesis that CAS thinking is able to help bridge the gap between western and eastern approaches to understanding the world, as was proposed by Capra (1975) and others at the time. A team in Singapore is working on this issue, led by Sim and Vasbinder (Sim & Vasbinder, unpublished 2015).

How far should scientists refrain from, or actively participate in, societal debates about the way forward? Here, sustainability is a good case in point. If, as scientists, we see a disaster such as a train wreck coming, should we limit ourselves (as many have) to impartially outlining the scientific conclusions, or should we go as far as warning society, or even engage in promoting what we see as necessary measures to avoid the disaster? The scientific community has not been able to develop

a consensus on this point, torn between the idea that articulating a specific position in this debate beyond simply presenting "the scientific facts" will weaken trust in science (as expressed by Merton in 1942), and the idea that if you can be sure that two trains are set to collide you have to take action.

In many ways, this debate is about whether a scientist views him- or herself first and foremost as a scientist and only secondarily as a citizen, or the reverse. Clearly, scientists just like any other people are complex systems and parts of wider systems. However, as actors, the way they view themselves and act upon that perspective is relevant to the ecology in which they function as individuals. My personal opinion is that as society pays for our education and our professional activities, we are first and foremost (educated) citizens, and it is therefore our role to choose among pathways for society and to promote our vision with due reference to the scientific underpinnings of our ideas, and clearly acknowledge where the science stops and our personal choices begin. The world has become so complicated and complex that the overwhelming majority of citizens can no longer identify ongoing dynamics clearly. As educated scientists, we must therefore accept our role in an intelligent manner.

A special aspect of this position is our attitude with respect to education. As I have argued earlier, if our societies (or their successors) are to survive as such, an emphasis on improving the education of our children and ourselves is fundamental. As scientists, we have a huge responsibility in that domain, but because, while we are paid by society to educate, our career structures are predominantly determined by research, that is not always sufficiently acknowledged. Reevaluating our role in this respect is part of what needs to be done.

NOTES

1 At a global level, democratic participation seems to be on the increase: (www.idea.int/gsod/files/IDEA-GSOD-2017CHAPTER-1-EN.pdf. (consulted January 10, 2018)

2 The data for national (and European) elections in many developed countries are available at www.idea.int/data-tools/data/voter-turnout (consulted January 10, 2018). Although there are always major fluctuations that are related to the issues at stake in any election, these data point to a decrease.

3 It is interesting in this respect to compare the classical Greek approach to the Judeo-Christian one. In the former, the gods behave like humans, whereas in the latter, people are striving to behave like gods (Lin Yutang 1998).

4 Wikipedia "transition towns," downloaded December 28, 2016).
5 The Chinese case-study in ShiShou is piloted by the Development Research Center of the State Council of the People's Republic (Yongsheng Zhang, PI), together with Hong Kong University of Technology and Arizona State University; the Japanese project is led by Professor Abe Kenishi of the Research Institute for Humanity and Nature in Kyoto; the Venice project is part of the GREEN-WIN project funded by the EU, led by Jochen Hinkel of the Global Climate Forum in Berlin.
6 See www.deltadevelopment.eu/en/.
7 For example, if under the current threat of companies misusing our personal data, the majority of participants in social networks would decide to cancel their memberships, a couple of major information technology (IT) companies would be in very serious difficulties, and non-IT-based social relationships would again flourish.
8 I am greatly indebted to Dean Christopher Boone of ASU for drawing my attention to this highly stimulating proximate vision of the ICT revolution.