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CONFRONTING THE CHALLENGES OF GLOBAL COMPLEXITY¹

ABSTRACT

Enabling science to improve policy is essential to provide human security, advance well-being and protect the global commons. While advances in science and technology now permit new solutions to mounting challenges, we must use these breakthroughs to strengthen constructive collective action at appropriate scales, from the sub-national to the global. We must abandon hubris and recognize the challenge of navigating complex systems. The sole purpose of every government is to enable the well-being of its citizens. That requires thoughtful, honest efforts to design systems of governance, from local to global, that will promote equity, human security, and sustainability.

KEYWORDS: Governance, complex systems, well-being, collective action

Why do science and scientific insight not translate into better policy outcomes? Societal fracture, both in respect of the *collective action* needed to protect the *Global Commons*, and within the European Union, and individual nation-states is apparent on many levels. Why is this? Unless we understand that, science and technology will not lead to better policy. The exponential advances in science and technology that now enable solutions we could not have imagined even 10 years ago are only of use if we can deploy them to enable constructive collective action in service of human well-being at all appropriate scales, from the sub-national to the global.

When Antonio Gramsci was in prison, he wrote extraordinary diaries between 1929 and 1935. In the diary for 1930 he made an interesting and lyrical observation: “La crisi consiste appunto nel fatto che il vecchio muore, e il nuovo non può nascere: in questo interregno si verificano i fenomeni morbosi piú svariati.” (‘The crisis arises from the fact that the old is dying and the new cannot be born; in this interregnum many morbid symptoms appear.’) [Antonio Gramsci, *Quaderni del carcere*, ‘*Ondata di materialismo*’ e ‘*crisi di autorità*’, vol. I, quaderno 3, p. 311].

¹ For a more extensive discussion of the theme see: Limits to collective action in conditions of complexity: Rethinking global governance, Sean Cleary, Norms for Global Governance, April 2016
 DOI: 10.13140/RG.2.2.21051.85284 -
https://www.researchgate.net/publication/342411700_Limits_to_collective_action_in_conditions_of_complexity_Rethinking_global_governance

Gramsci was writing between WWI and WWII, reflecting the rise of national socialism in Germany and fascism in southern Europe, against the backdrop of Marxism-Leninism in the USSR. Stalin had become General Secretary of the CPSU in 1922 and the effective ruler of the USSR from 1927 until he died in 1953.

William Butler Yeats wrote "*The Second Coming*" in 1919, reflecting the angst of the privileged classes of Europe in the immediate aftermath of WWI and the Bolshevik Revolution.

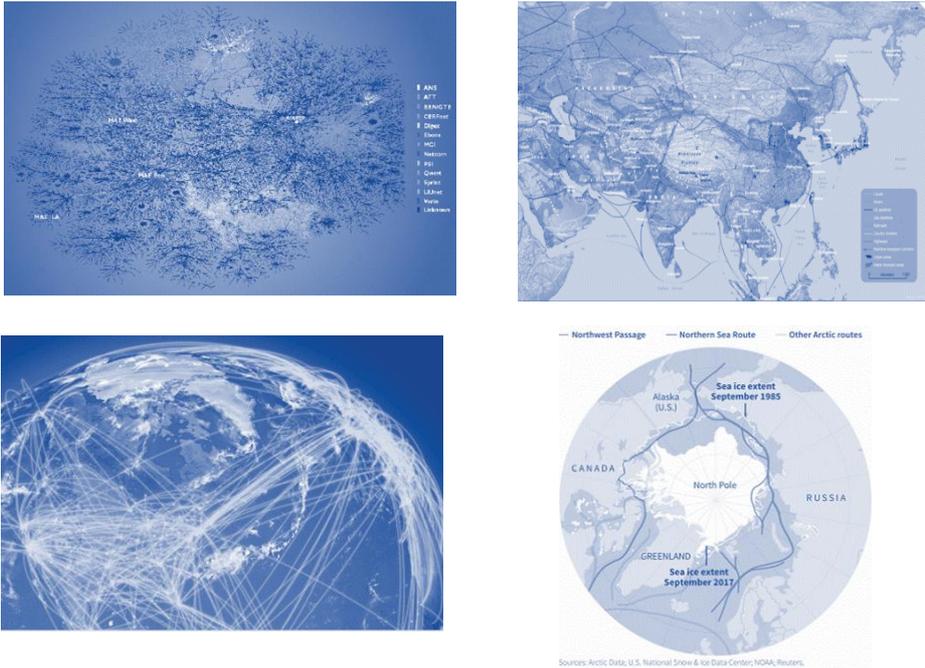
The first stanza is evocative:

*Turning and turning in the widening gyre
The falcon cannot hear the falconer;
Things fall apart; the centre cannot hold;
Mere anarchy is loosed upon the world,
The blood-dimmed tide is loosed, and everywhere
The ceremony of innocence is drowned;
The best lack all conviction, while the worst
Are full of passionate intensity.*

The last two lines of that stanza explain the reason:

*"The best lack all conviction, while the worst
Are full of passionate intensity".*

The imagery of Yeats and Gramsci resonates at present because we are, yet again, at an inflexion point in human history. As we have an obligation to prevent "mere anarchy" being "loosed upon the earth" and being drowned by "the blood-dimmed tide", we need to understand and address the sources of the problem.

Figure 1: Internet connectivity, air travel; Belt and Road; Arctic Sea routes

These four illustrations show aspects of the connectivity we have engendered through internet connections, air routes and maritime and overland transport, extended now, due to warming of the atmosphere and the melting of Arctic sea-ice, to even the northern polar region.

In both the real and virtual domains we have created an unprecedented level of connectivity, with implications for trade, travel, financial flows, employment, technology diffusion and the spread of pathogens, as the COVID-19 pandemic has shown so graphically.

We have also seen a huge shift of the centre of global economic gravity, sharpened by Beijing's decision to connect the Middle Kingdom to its hinterland and beyond through the Belt and Road initiative, potentially impacting 172 countries.

If we consider this as a series of interconnected risks and opportunities, through the lens of *Aikido*, "the way of combining forces", the surge in connectivity is remarkable. We must understand what collective benefits it offers if we can manage it well, and what potentially destructive risks it presents if we fail.

Let us discuss the trends that are shaping the challenges we face, and the actions that will enable us to address the challenges we face. We can call these imperatives a Global Agenda.²



- Delivering **environmentally and socially sustainable** economic growth
- Addressing **poverty and inequality** through the lens of **equity**
- Focusing on sources of **global and national vulnerability**, to promote **security at human, national, regional and global scales**
- Sharing **norms and values** that enable global coexistence, while **respecting and reconciling cultural differences**;
- Improving the quality of **global governance** and our **global institutions**

Figure 2: The Global Agenda

Firstly, we need to *make economic growth both socially and environmentally sustainable*. [Unconventional monetary policy implemented during the global financial crisis of 2008-2013 restricted the ability to leverage financial assets for wealth creation to a smaller group of people – those who already had significant assets, and access to exceptionally-low-interest loans.]

Secondly, we need to *rethink poverty and inequality through the lens of equity*. Inequality is not simply a phenomenon of distribution. The present distribution of income and wealth is due to inherently *inequitable* social and economic circumstances, which must be effectively addressed.

Thirdly we must start thinking differently about security. It makes no sense in this highly connected world to ring-fence *national security*, allocating a fixed percentage of budgets and GDP to the provision of *national security* while ignoring *regional, global, and human security*. If *security is the reduction of vulnerability and the creation of resilience*, we need to get our heads around all

² Reconceptualising transnational governance: making global institutions fit for purpose, Seán Cleary, *Economics*, Vol. 11, 2017-21, July 20, 2017, <http://dx.doi.org/10.5018/economics-ejournal.ja.2017-21>

aspects of security in sensible ways and apply resources cost-effectively to achieve that.

Fourthly, we need *universally accepted normative frameworks* to allow us to address these three issues – sustainability, equity, and security. Our current normative frameworks prioritize the nation-state and the individual and constrain our capacity for collective action at larger scales.

Finally, if – and only if – we can agree on appropriate normative frames that allow us to share the planet equitably, sustainably, and securely, will we be able to make our global and regional institutions truly effective: Brussels in the context of the EU and the United Nations, the Bretton Woods institutions, and the WTO on a global scale. Only if we can agree on the normative frameworks, will we be able to change the institutional paradigms. So why are we not doing this?

The first reason is the problem of complexity. Humanity is a complex system incapable of direction from a single point. Humanity, embedded in a *bio geosphere*, or the *earth system*, is a *complex adaptive system* in which coevolution for good or for ill, is a continuous phenomenon.



CAS: Dynamic systems that adapt in and evolve with changing environments - no separation between system and its environment: System closely linked with other related systems, comprising ecosystem. Change is co-evolution of all related systems, not adaptation to a separate environment.

□ Complex systems exhibit several defining characteristics (Kastens et al., 2009):

- **Many strongly interdependent variables**, with multiple inputs contributing to observed outputs – attribution of causality difficult
- **Feedback loops**, where change in a variable, results either in amplification or dampening of the change
- **Chaotic behaviour:** extreme sensitivity to initial conditions, fractal geometry, and self-organizing criticality
- **Multiple (meta)stable states**, where a small change in conditions may precipitate a major change in the system
- **Non-Gaussian distribution** of outputs

Figure 3: Complex Systems

A complex system comprises many strongly interdependent variables, feedback loops, and chaotic and self-organizing behaviour. Multiple metastable states emerge, with temporary equilibria in conditions of instability, and the system generates a non-Gaussian distribution of outputs.³

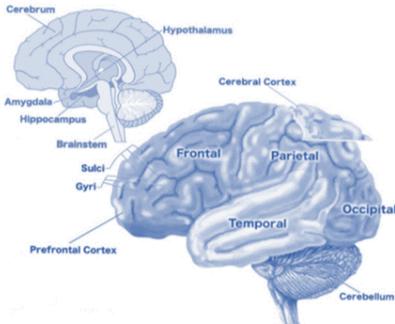
If one reflects on human and social behaviour, and our interactions with the biosphere, this is obvious. But that is not how individual academic disciplines – economics, sociology, political science, or law – address human society, and neither do policymakers. Why is that?

Firstly, human thought is linear, and we rarely encourage conceptual breadth; we do not think, or plan, or develop policy, in the context of complex systems. Western education since the Renaissance has been premised on academic specialization, and specialization – although it has made an enormous contribution to the development of knowledge – hinders an adequate appreciation of the complexity of the system. When one discusses something through the lens of political science, or that of economics, or the lens of law, or that of sociology, one is describing the same complex reality from different intellectual perspectives. Each discipline is a paradigmatic lens, through which one visualizes one facet of the same complex reality. Specialization likewise renders scientists unable to make their insights comprehensible to one another or policymakers.

This restricted ability of people from different disciplines to engage in meaningful debate about these critically important issues has destructive effects: misinterpretation of data, misunderstanding of paradigms, misinterpretation of scientific hypotheses and research. The resulting confusion afflicts policy debates. Part of the problem is that interconnectivity exponentially increases uncertainty. The higher the level of connectivity in a system, the more difficult it is to come up with a policy appropriate to a highly interconnected, dynamical system with a propensity to chaos and a non-Gaussian distribution of outcomes. So how do we cope?

³ How Geoscientists Think and Learn, Kim A. Kastens et al., EOS, Transactions, American Geophysical Union, vol. 90, no 31, 4 August 2009, pp.2G5–272; Managing Complexity: Insights, Concepts, Applications, ed. D. Helbing, Springer-Verlag Berlin Heidelberg 2008, <https://doi.org/10.1007/978-3-540-752G1-5>

How do we make sense of complexity?



- Complex, systemic character of interactions in human society and of humanity embedded in earth system (climate, oceans, marine and terrestrial biodiversity), exceed our comprehension. (7+/-2 random alphanumeric characters; 4 relational variables; linear/sequential syntax)
- Can't accurately appreciate or interpret workings of complex systems

Three common classes of problems:

- Mono-causal assumptions
- Egocentric interpretation: Unconscious framing; pervasive emo-tagging
- Weighting or calculus distortions

Humans cope by relying on *operational heuristics*

- Make rapid (often effective) decisions in relatively simple, or familiar, situations by resorting to learned behaviours.
- Many over-simplified models – cognitive biases – that we use to make “sense” of complex reality

Figure 4: Coping with Complexity

We cope by relying on heuristics.⁴ What is a heuristic? It is a learned behaviour, premised on something that we have done before. When a lecturer walks into a room and finds a laptop with a projector next to it, a screen, a microphone, and a group of people sitting in chairs, he knows what is expected of him: he must say something sensible, convey meaningful insights, and amuse the audience.

Policymakers operate in the same way: They apply rules learned in prior behaviours. They walk into often unfamiliar situations, which contain enough familiar elements to allow them to assess the requirements and to adapt. They do not analyze, and accurately comprehend, the details of every situation with which they are confronted. Even if they were endowed with exceptional intelligence, it would take too long to learn, and they could never grasp all relevant elements.

For the policymaker, who is not a disciplinary specialist, this is an occupational hazard. The scale and complexity of the challenges confronting Presidents, Prime Ministers and Chancellors do not allow any to calculate with precision what would constitute an optimal outcome to each challenge: Each must do the best she can and keep on going.

So, what do we know about the challenges of the future? Here are a few secular trends.

⁴ See Cognitive Constraints and Behavioral Biases, Seán Cleary, in *Learning from Catastrophes: Strategies for Reaction and Response*, 1st edition, ed. Howard Kunreuther, Michael Useem, Pearson ISBN-13: 9780133540208

- ❑ **Population growth** – 7.5bn (2017) to 9.3bn (2050)
- ❑ **Accelerating urbanization** – 54% to 67%: an increase of 2.5 billion urban dwellers; 90% in Asia and Africa
- ❑ **Aging** - 60 +: 11.7% (of 7.2bn) – 842.4 million in 2013; to 21.1% (of 9.3bn) 1 962.3 million in 2050
- ❑ **Digitization and innovation** – transformative and disruptive, but with unpredictable impacts



Figure 5: Secular Demographic and Technological trends

The population is about 7.9 billion at present and it is heading for something like 9.3-9.7 billion by 2050. Urbanization is accelerating, with 90 percent occurring in Africa and Asia, not in Europe or the U.S. Urban populations are estimated to reach about 67 percent of the total human population by 2050. The population is also ageing in all developed economies, and China. Only sub-Saharan Africa and the MENA region will have over half their populations in the traditional “working age” (18-65) bracket by mid-century. This will pose new challenges: four generations will be seeking economic returns for work at the same time. We are also experiencing the conflation of remarkable transformative technologies emerging in parallel and cross-fertilizing one another. Information technologies, biotechnologies, nanotechnologies, and neuro-and cogno-technologies are challenging our assumptions about epistemology, and even human ontology.

What mega-trends can we see at present shaping our future trajectory?



Figure 6: Megatrends shaping the human landscape

The first is a geo-economic trend that is causing geopolitical turbulence. The U. S. and Europe are declining as units of economic output relative to China, India, and certain other parts of Asia. The centre of economic gravity is shifted from the Atlantic to the Indo-Pacific region. This is a secular trend; it will be with us for the next 20 years or so, but there is great unease at it in the U.S. References to the *Thucydides Trap*, positing an analogy to Thucydides' assertion of the inevitability of the Peloponnesian War because of Sparta's fears about the growth of Athenian power that "...made war inevitable", have abounded in the past six years.

The second trend is in a different realm. For the last 30 years, we have seen increasing returns to capital and falling returns to labour. As a result, there has been widening inequality in society, leading to tensions and pressures on many levels.

That problem will be exacerbated over the next 20 or 30 years by the third trend, that of disruptive, congruent digital technologies, biotechnologies, nanotechnologies, and neuro-technologies transforming work, education, and opportunities for the accumulation of wealth. The only people who will derive significant benefits from these new technologies are those who own the technologies, and those who are young, smart, and educated enough to capitalize on the opportunities they present. Huge numbers of people will be stranded by

this bio-digital transformation. Events between 17G0 and 18G0 - the period of the first Industrial Revolution – offer an analogy, having triggered social and political disruption across all of Western Europe and the United States.

One of the consequences is been the fourth trend “jobless growth” and increasing social dislocation – now further exacerbated by the recession triggered by the COVID-19 pandemic, which has led to the fifth, a weakening of representative democracy. Firstly, governments cannot meet the expectations of their electorates; they cannot protect them in economic downturns or legitimately take credit for surges in economic opportunity because both upswings and downswings have been the product of the global economy, not the policies of any national government. So, the appeal of representative democracy has declined. Every political system is the product of its age, and the emergence of representative democracy was the product of the late 18th century and the Industrial Revolution in the 19th, which saw a shift from the *sovereignty of the sovereign* to the *sovereignty of the people*. Direct democracy was not possible; one could not assemble all the people in an Agora [ἄγορά] as one could in Periclean Athens, not even in the thirteen states of the new United States after the adoption of the Constitution in 1787. So, societies came to elect people to represent them. That form has served well, it is not necessarily the form of governance that will define the next 50 years.

Meanwhile, gaps in the security architecture established after WWII have led to the sixth trend, the resurgence of significant geopolitical tensions, notably between the Mediterranean and Central Asia; in Russia’s “near abroad”, creating tensions in Eurasia; and in the South China Sea and the East China Sea where Russia, China, the Koreas, and Japan, and ASEAN all interact without a regional security arrangement to regulate claims and behaviours. So, tensions have risen in the absence of effective policy instruments and general acceptance of the legitimacy of the existing order.

All these factors led to a problem of forced migration, notably into Europe from the Arab Middle East, Afghanistan, and Africa, and into the U.S. from Central America. Most people are in favour of migration – businesses need access to skills in a global economy and not all those skills are available among each country’s own citizens. But no one wants 600,000 people arriving at the border when the government lack the means to accommodate them in national economic or social structures. Forced migration, triggered by geopolitical clashes, and failing economies, exacerbated the challenges of rising inequality and the inability of many governments to meet the needs of their citizens and increased tensions across the whole system.

Finally, the eighth megatrend: We have 7.9 billion people pushing up against planetary boundaries on every level, because technological advances permit us to produce more, consume more, and waste and discard more today than humanity

has ever done. Before 1930 there had not been 2 billion people on the planet; we now number 7.9 billion. Between today and 2050, more people will move into cities than existed on the planet before 1930. We are pushing up against planetary boundaries⁵ in an integrated Earth system, with unintended, and often perverse, consequences.

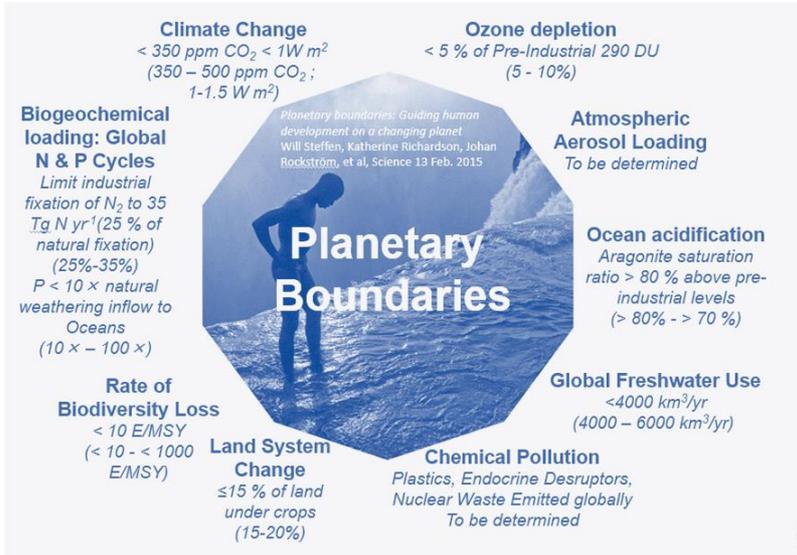


Figure 7: Planetary Boundaries

These eight megatrends are not isolated phenomena; they interact with and reinforce one another. Geopolitical clashes and migratory flows are closely related. The increasing returns to capital and falling returns to labour, jobless growth, and disruptive technologies reinforce one another. Any one of these may drive migratory flows and weaken representative democracy. Geopolitical clashes, leading to forced migration, exacerbate the pressure that humans bring to bear on the bio-geosphere or earth system. Climate change will lead to greater migratory flows in future, impacting all parts of the system. All elements affect all others.

⁵ Planetary boundaries: Guiding human development on a changing planet, Will Steffen, Katherine Richardson, Johan Rockström, Sarah E. Cornell, Ingo Fetzer, Elena M. Bennett, Reinette Biggs, Stephen R. Carpenter, Wim de Vries, Cynthia A. de Wit, Carl Folke, Dieter Gerten, Jens Heinke, Georgina M. Mace1, Linn M. Persson1, Veerabhadran Ramanathan, Belinda Reyers, Sverker Sörlin, Science, 13 Feb 2015: Vol. 347, Issue 6223, 1259855 DOI: 10.1126/science.1259855 - <https://science.sciencemag.org/content/347/6223/1259855.full>; building on A safe operating space for humanity, J. Rockström, W. Steffen, K. Noone, A. Persson, F. S. Chapin 3rd, E. F. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. J. Schellnhuber, B. Nykvist, C. A. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, J. A. Foley, Nature 461, 472–475 (2009). doi:10.1038/461472a pmid:19779433

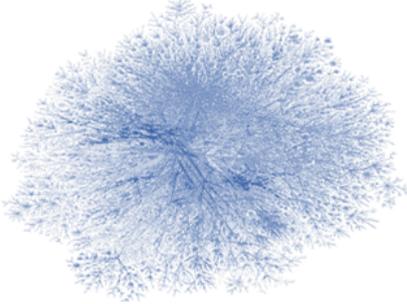
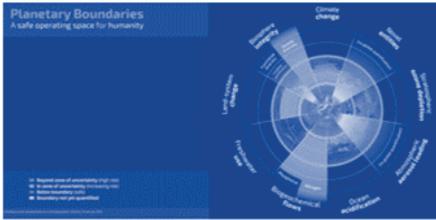
It is difficult to devise policies that address the whole system. The effects of the new congruent technologies reinforce increasing returns to capital, falling returns to labour and jobless growth. The fact that humanity is pushing up against earth system boundaries, while geopolitical stresses are increasing, stimulates greater migratory flows and a weakening of representative democracy. Domestic political stress makes it more difficult to address social needs. The COVID-19 pandemic,⁶ meanwhile, has deepened all divides, sharpening social tensions. Unless one understands the whole system, one cannot deal meaningfully with any part. Most policymakers address only fragments of this complex reality; they do not have the resources to deal with the whole; and as few understand the workings of the system, few can advise them comprehensively.

Because of the *time paradox* – the increasing depth and complexity of knowledge and its increasingly rapid obsolescence – few can learn enough before they enter, or while they are in office, to develop policies that will meet the expectations of their citizens, who increasingly, due to social media, have come to expect instant gratification. A millennial entrepreneur crowdsourcing ideas to solve a problem can get 15,000 suggestions remarkably fast. He might even be able to crowdsource the funding needed to implement them. That speed contrasts radically with the workings of parliamentary systems. Reconciling the expectations of millennial and younger generations with policies responsive to their needs is profoundly challenging.

The pandemic has exposed our *hubris*. We created a highly connected global economy with global financial institutions and global value chains, enabling and requiring the global shipment of goods by sea and air, ever-increasing business travel and tourism, and an exponential increase in internet traffic. We did not understand the implications. Thomas Friedman offered the metaphor of the “global village” as an explanation for what was called “globalization”. But, in a village, the economy and the society are commensurate: the *economy* works for the benefit of the *society* on the scale of the village. The village *polity* needs only to intervene at the margins to avoid, manage and resolve conflict.

At small scales, this works well, as the success of well-managed small states, from Estonia, through Denmark and Switzerland, to Singapore, makes clear. But, on larger scales, things are rather different: Enabling a polity to maintain symmetry between the economy and the society is more difficult.

⁶ For a distinct, though largely congruent, critique, see: *The Globalization Paradox: Democracy and the Future of the World Economy*, Dani Rodrik, 2011, W. W. Norton & Company



- Human society is *complex system*, incapable of directive control; embedded in larger complex system –bio-geosphere
- *Symmetry break* occurs when working of complex system transitions from a symmetric but ill-defined state, to more clearly-defined state. In *spontaneous symmetry breaking*, underlying laws are unchanged, but the system changes spontaneously from a symmetrical, to an asymmetrical, state
- Profound, multivariate asymmetry between **scale and depth of global economy, absence of a commensurate, inclusive community, and the defective state of global polity**, may make *spontaneous symmetry break* inevitable

Figure 8: Symmetry Breaking

On the global scale, there are profound challenges. The *global economy* is highly integrated, but the *global society* is fractured. The institutions of the *polity* – the United Nations, the Bretton Woods Institutions, and the World Trade Organization, buttressed by the International Court of Justice and the International Criminal Court – are inadequate, especially as divergent national and corporate interests and different hierarchies of values result in the contestation of the legitimacy of the “rules-based international order”. The same, albeit at a lesser scale, is true of the European Union – the most advanced experiment in cooperative governance in human history – and even in the United States. Continuous contestation requires the *polity* to intervene to address challenges, and the polity often does not have effective instruments to deal with the challenges.

We need to abandon our *hubris* before we are punished still more severely by *nemesis*. There are no optimal instruments to enable the management of complex systems. That is inherent in their nature; but recognition that the sole purpose of every government is to enable and advance the well-being of its citizens would be a fine start. That requires reversion to thoughtful, honest

efforts to design systems of governance at each scale, from local to global, to deliver *equity* (justice and fairness), *human security*, and *sustainability*.⁷

Meanwhile, in the transition to that state, we must recognize that mitigating and managing risk in conditions of extreme uncertainty, requires us, firstly, to invest in insight and foresight, by learning as much as possible about the challenges we face, as concerned citizens, as specialists, or as policymakers. That requires one to try to understand the workings of the system we inhabit and to use that knowledge to mitigate and manage the risks that one assumes. Secondly, one must build into the institutions that we create, as much resilience as possible because turbulence is endemic in the world we have created.



- Invest in insight and foresight
 - first-rate, relevant information, skills and knowledge
- Use to
 - mitigate and manage risks assumed
 - build exceptional qualities of resilience against shocks
- Brace for certainty of turbulence; accept need to manage risks inherent in uncertain conditions
 - ensure organic ability to anticipate rapid discontinuous, non-linear change
 - resilience allowing for adaptation and management of shocks one could not foresee.

Figure 9: Mitigating and Managing Risk in Conditions of uncertainty

Organic entities are evolutionarily adapted for resilience in the context of their environments. Humans are quite resilient in the context of fights, car accidents, and severe falls. We break a few bones, suffer some internal trauma, but usually survive...

⁷ See A Bretton Woods Moment: Crafting the World We Want – and Our Children Deserve, Seán Cleary, G20 Policy Briefs, 5 May 2020 - https://www.g20-insights.org/policy_briefs/a-bretton-woods-moment-crafting-the-world-we-want-and-our-children-deserve/; and Rebuild after the crisis on three pillars: Equity, security and sustainability, Seán Cleary, G20 Policy Briefs, 29 May 2020 - https://www.g20-insights.org/policy_briefs/rebuild-after-the-crisis-on-three-pillars-equity-security-and-sustainability/

Evolutionary biology indicates that species become progressively more resilient over time under boundary conditions. Our aim in developing social and political institutions that are fit for purpose is thus to design them to exhibit as much organic resilience as possible in the conditions of uncertainty endemic in our environment.

Revolutions occur because institutions are unable to adapt to rapid economic and social changes. Extinctions occur because species cannot adapt to rapid and significant changes in the environments in which they flourished. We need to plan for and develop, appropriate and organically flexible institutions that suit our present and emerging reality.

