Revista CIDOB d'afers internacionals, n.º 95, (septiembre 2011)

Complexities and futures?

¿Complejidades y futuros?

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ABSTRACT

Physical and social worlds are full of change, paradox and contradiction. There are no simple, unchanging stable states or states to which there is equilibrium-establishing movement. The "normal" state is not one of balance and equilibrium. Any system is "complex". Policies never straightforwardly restore equilibrium. The equilibrium models dominant in most economic system analyses, especially general equilibrium models, can be critiqued since they ignore the huge array of positive feedbacks. Thus, systems should be viewed as dynamic and processual, demonstrating the power of the second law of thermodynamics, in which physical and social systems are seen as moving towards entropy. Systems can be broadly viewed as unpredictable, open rather than closed, with energy and matter flowing in and out. Systems are characterised by a lack of proportionality or "non-linearity" between the apparent "causes" and "effects" of events and processes. Various implications for thinking futures are examined in the light of this complex systems thinking.

Key words: Complexity systems, futures, mobility, crisis

RESUMEN

Los mundos físico y social están repletos de cambios, paradojas y contradicciones. No existen estados simples, estables e inmutables, ni estados con un movimiento establecido equilibradamente. El estado "normal" no es de estabilidad y equilibrio. Cualquier sistema es "complejo". Las políticas nunca restablecen el equilibrio de manera directa. Los modelos de equilibrio que dominan la mayoría de los sistemas de análisis económicos, en especial los modelos de equilibrio general, pueden ser objeto de crítica en la medida que ignoran la enorme variedad de retroalimentación positiva. Así, los sistemas deberían ser vistos como dinámicos y procedimentales; ello demostraría el poder de la segunda ley de la termodinámica en la cual los sistemas sociales y físicos son vistos como un movimiento hacia la entropía. Los sistemas pueden ser ampliamente considerados como impredecibles, más abiertos que cerrados, con energía y materia que fluye hacia dentro y hacia fuera. Además, se caracterizan por una falta de proporcionalidad o "no-linealidad" entre las "causas" aparentes y los "efectos" de los acontecimientos y los procesos. En este trabajo se examinan diversas implicaciones para reflexionar sobre el futuro a la luz de esta teoría de sistemas complejos.

Palabras clave: Sistemas complejos, futuros, movilidad, crisis

SYSTEMS THINKING

My starting point here is that physical and social worlds are full of change, paradox and contradiction. There are no simple unchanging stable states or states to which there is equilibrium-establishing movement. Physical and social worlds, such as that of European space, can be characterised through the strange combination of the unpredictable and the rule-bound that governs people's lives. So there are three aspects here: patterned, regular and rule-bound systems; these rule-bound workings can come to generate various unintended effects; and unpredictable events can disrupt and abruptly transform what appear to be these rule-bound and enduring patterns.

In such a state then the 'normal' state is not one of balance and equilibrium. For example, populations of species can demonstrate extreme unevenness, with populations rapidly rising when introduced into a given area and then almost as rapidly collapsing. Any system is thus 'complex'. Policies never straightforwardly restore equilibrium, unlike the claims of policy-makers. Indeed, actions often generate the opposite or almost the opposite from what is intended. So many decisions intended to generate one outcome, because of the operation of a complex system, generate multiple unintended effects that can be very different from what is planned.

Systems thus generally do not move towards equilibrium. Much writing in economics presumes that feedbacks will only be negative, and hence equilibrium-restoring. The equilibrium models dominant in most economic system analyses, especially general equilibrium models, can be critiqued since they ignore the huge array of positive feedbacks. Positive feedback mechanisms take systems away from equilibrium states. Thus systems should be viewed as dynamic and processual, demonstrating the power of the second law of thermodynamics, in which physical and social systems are seen as moving towards entropy. Systems can be broadly viewed as unpredictable, open rather than closed, with energy and matter flowing in and out. Systems are characterised by a lack of proportionality or 'non-linearity' between the apparent 'causes' and 'effects' of events and processes. There *can* be small changes that do bring about big, non-linear system shifts, as well as the converse where what seem like major causes engender almost no consequence.

In such analyses it is clear that not everything changes. Certain systems can be stabilised for long periods, such as the car system which has been more or less unchanging in its crucial features since the late 1890s. Causation flows from contingent events to general processes, from small causes to large system effects, from historically or geographically remote locations to the general. Systems thus develop through 'lock-in', but where only certain small causes are necessary to prompt or tip the initiation of each 'path'. Systems once established can get 'locked in' and their patterns and rules survive

for long periods, even though there appear to be strong forces that 'should' have undermined them. Social institutions matter a great deal as to how systems develop. Overall systems adapt and co-evolve in relationship to each other and hence possible futures are irreducible to single 'structures', 'events' or 'processes'. Futures are messy and complicated and exceptionally hard to predict, let alone bring about.

Moreover, movement from one state to another can be very rapid, with almost no stage in between. These strikingly abrupt transformations are called phase transitions. For example, as a gas is cooled it remains a gas until it suddenly turns into a liquid. This rapidity can also be seen in transformations between each ice age and the periods of relative warmth that occurred in between. There are only two states – the glacial and the interglacial, with no third way. Research in the last decade exploring ice cores up to a mile or so thick shows that there was abrupt movement from one state of the earth's system to the other with almost no periods of time in between the two. This notion of abrupt change is what has animated some of the recent dire warnings of unstoppable climate change.

The importance of small but potentially fateful changes is often described through the theory of 'black swans', which are those rare, unexpected and highly improbable events that can nevertheless have huge impacts. These events are outliers, not averages. Black swans are responsible for much economic, social and political change in the world. They make history not crawl but jump. The most important events are those least predictable. Thus, when change happens, it may not be gradual but occurs dramatically, at a moment, in a kind of rush. If a system passes a particular threshold, switches or tipping points occur through positive feedback and 'punctuated equilibria'. The system turns over.

TWENTIETH CENTURY SYSTEMS

Almost all systems significant in the contemporary world are simultaneously economic, physical, technological, political and social. And there is increased interconnectedness or the linking of system components through software, cybernetic architecture and a networked character of life.

In the first half of the twentieth century, a number of high carbon systems were established, first in the US and then spreading around the world. The impact of these interdependent systems has been momentous for the very nature of economic and social life. Much of the post-war history of Europe has involved efforts to spread these systems

across the European space so that 'Europe' has tried to catch up with North America. This has then helped to generate high carbon systems around the world.

The systems that came to be established were as follows. First there was the development of electric power and national grids, so ensuring that more or less every home in the global north is lit, heated and populated with electric-based consumer goods which rely especially on coal and gas. Second, there is the spreading of the steel-and-petroleum car (now over 650m cars worldwide) and associated roads and a widely distributed, or sprawling, infrastructure linking most places of residence, work and leisure. Third and relatedly, there is the development of suburban housing distant from places of work and which has to be commuted to by car/bus and can be filled with household consumption goods powered by electricity. Fourth, various electricity-based technologies emerge, such as standalone telephones, computers, laptops, networked computers, mobile phones, blackberries and so on, which network colleagues, friends and families who are now enabled to be more geographically dispersed as to where they live, work and engage in leisure. Finally, many specialized leisure sites, supermarkets, fast food, national parks, sports stadia, theme parks proliferate. Most of these necessitate travelling from home and neighbourhood, especially by car and new systems of air travel which were invented around the time of the steel-and petroleum car (as well as the long distance movements of objects and water).

MOBILITIES

Central to these systems are multiple mobilities. These are the corporeal travel of people for work, leisure, family life, pleasure, migration and escape, organized in terms of contrasting time-space patterns ranging from daily commuting to once-in-a-lifetime exile; the physical movement of objects include food and water to producers, consumers and retailers, as well as the sending and receiving of presents and souvenirs; imaginative travel effected through the images of places and peoples appearing on and moving across multiple print and visual media, and which then construct and reconstruct visions of place, travel and consumption; virtual travel often in real time transcending geographical and social distance and forming and reforming multiple communities at-a-distance; and communicative travel through person-to-person messages via personal messages, postcards, texts, letters, telegraph, telephone, fax and mobile.

In the post-war period these mobility systems have got much faster. Fast travel has been generated through the growth of automobility throughout the world, increasingly

so in the world's two most populous societies of China and India. Second, there has been the rapid growth of cheap air travel based on new budget business models, as well as a significant resurgence of rail transport, especially of high speed trains across Europe and Japan. Third, there are increased 'miles' both flown on the world's airlines and travelled on the world's 90,000 ships by manufactured goods, by many different components and by foodstuffs (hence the importance of 'foodmiles'). Fourth, much greater distances are travelled by work colleagues, members of leisure organizations, families and friends in order to sustain patterns of everyday life that are 'at-a-distance'. There has been a marked growth in 'family miles' and 'friendship miles', as well as the development of new kinds of globally-significant themed leisure environments that have to be visited from afar. As a consequence, carbon use within transport accounts for around a quarter of total greenhouse emissions. It is the second-fastest growing source of such emissions and is expected to double by 2050.

MULTIPLE CRISES

Along with global climate change, other causes of physical and social catastrophe are thought increasingly likely. One of these is the probable decline in the availability of energy (especially oil and gas) over the next few decades. Oil has made the world go round. It is essential to the European space and yet it is running out despite the fact that it currently accounts for over 95% of transportation energy. There is no plan B when oil goes past peak and its price rapidly escalates, as it did in the mid years of the last decade.

Furthermore, the world's population is growing by about 900 million per decade; the largest absolute increases ever recorded in human history. By 2000 the world population passed 6 billion and is expected to reach 9.1 billion by 2050, if one or more catastrophes do not intervene. Rapid population growth in developing countries especially exposes populations to many hazards, shortages of clean drinking water and sanitation as well as rising air pollution and air-born toxins. Most mega-cities within developing countries fail to meet WHO (World Health Organization) standards for air quality. Rising populations also add to the global consumption of energy and raw materials, as well as environmental carrying capacity, leading to further resource depletion.

Moreover, the world went urban on May 23rd 2007. We now inhabit an 'urban planet'. Cities consume three-quarters of the world's energy and are responsible for at least three-quarters of global pollution. Indeed while cities were once viewed as the cradle

of civilisation, they now produce disastrous social inequalities, environmental decline and 'global slums'. The cities of the future, rather than being made out of glass and steel, are largely constructed out of crude brick, straw, recycled plastic, cement blocks, and scrap wood. Much of the world's population squats in squalor, surrounded by pollution, excrement, and decay. These are the dwelling places for at least 1 billion people in the world today.

Food and water security are increasingly significant. Much food production depends upon hydrocarbon fuels to seed and maintain crops, to harvest and process them, to transport them to market, partly because of the exceptional food miles that have come to be involved in diets in the rich north. If oil shortages develop further, food could be priced out of the reach of the majority of our population. Hunger could become commonplace in every corner of the world, including your own neighborhood. There are likely to be food protests as a result of likely flooding, desertification and generally rising costs, as well as the tendency for 'rich' societies to buy up land in 'poor' societies to ensure their own food security (as Qatar is now doing).

There are also growing insecurities in supplying clean usable water. There are huge demands from growing populations, especially those in mega-cities that have to both buy and transport, using carbon-based systems, their water from outside. A global temperature increase of 2.1 degrees would expose up to 3 billion people to water shortages. Some commentators now refer to 'peak ecological water', only 0.007% of water on Earth being available for human use. Already severe water shortages face one third of the world's population.

These very significant processes are impacting upon human societies and likely to shape their future. Each concerns the resource-base of societies and derives from various social institutions and practices. How social life has come to be organized determines the scale and impact of such resource-use and how consequences may ensure that the system consequences are in part at least 'perverse'.

Moreover, the economic and financial collapse of October 2008 and its ongoing consequences across the rich north have put epochal change on the agenda. Commentators had not presumed that the world's production, financial, real estate, consumption and income systems could rapidly reverse. Systems had often been thought of as like oil tankers, which take an inordinate time to set onto a different course. But the world economy-society showed no such properties. It seems to have flipped over, from increasing prosperity and richer lives for many in the prosperous north to increasing misery for many. A set of tipping points were encountered, and at breakneck speed all that had been presumed 'solid' about the world economy-society 'melted into air', to use Marx's terminology from the *Manifesto of the Communist Party.*

This has been an extraordinary turnaround in human history, a turnaround that those in the rich north never expected to see and experience, although other parts of the

world have experienced massive financial reversals within the previous decade or two. Lives had been premised upon increasing incomes, wealth, security, movement, knowledge, wellbeing and longevity. This was the dream of the modern epoch, apparently set in stone in the rich north since 1945. And yet there might be a reverse gear. This crisis shows that the private pursuit of individual gain around the world can well result in collective outcomes that threaten the very future of capitalism. In September 2008 the value of the world's financial assets had grown to a staggering $160 trillion, 3.5 times the value of world GDP. The pursuit of individual gain thus produced what most now understand as an economy that was hugely over-financialised, where the balance between real resources and financial economies was contradictory.

This turnaround came about through certain interdependencies between systems which are not 'silos'. It is necessary to examine how these different processes develop, how they interconnect and, especially, how they may concatenate. One crucial reason for potential global disaster is the way that systems are increasingly seen as interacting with each other. Societies face crisis when they are hit by multiple shocks or multiple stresses simultaneously. Human and physical systems exist in states of dynamic tension and are especially vulnerable to dynamic instabilities. Various systems may well come to reverberate against each other and generate impacts upon larger systemic changes. It is the simultaneity of converging shifts that create significant changes. Thus resource depletion, climate change and other processes may come to overload a fragile global system, creating the possibility of catastrophic failure.

One local example of such concatenation occurred in New Orleans in September 2005, a place like many others built close to the sea and threatened by extreme weather events. Hurricane Katrina showed what happens to those living in a major rich city when an extreme weather event washed away many of the resources of poor people forced to live close to the sea. TV pictures showed how whole populations are 'disposable' with bloated corpses of the black poor being displayed on the billion or so TV screens around the world. Katrina also showed the vulnerability of oil supply to the localised flooding that took place in the Mississippi delta. The world's refineries were already working to maximum capacity and so were unable to raise production when the Mississippi refineries shut down, and as a result shortages were common and oil prices soared, contributing to the oil price hikes that characterised the mid 2000s and which helped to undermine the sub-prime mortgage bubble.

This shows in a small way how states even in rich societies are often unable to cope with crises, with potential oil shortages, droughts, heat waves, extreme weather events, flooding, desertification, highly mobile diseases and the potential forced movement of millions of environmental refugees. States have to deal with such concatenating processes, even though their tax revenues have been reducing because of the proliferation of offshored tax havens designed to avoid or evade tax payments.

Some commentators would argue that the arguments here are overstated and that there will be business as usual and a perpetual motion future can in fact be envisaged. Such a Corbusier-ian future would involve hypermobility based on some new set of post-oil technologies; patterns of mobile lives based on novel communication and transportation practices develop on an extreme scale; resource shortages and effects of climate change turn out to be much less significant at least for those in the rich north whose movement – especially above the ground, in the air, gets more extensive, frequent and part of their very 'persona'; people are 'always on', with messages and individual media streamed continuously to miniature intelligent devices which connect consumers directly with global wireless networks especially when 'on the move', which they are much of the day and night; most citizens travel four to five hours a day; and for leisure there are regular special trips into at least inner space (http://www.youtube.com/watch?v=wa2DUe2vJew (accessed 16.12.2008)).

So this is one future. An alternative is a catastrophic future involving the concatenation of climate change, future, oil, gas and water shortages and intermittent wars leading to the substantial breakdown of many mobility, energy and communication connections that straddle the world. There would be a plummeting standard of living, a re-localization of mobility patterns, an increasing emphasis upon local 'warlords' controlling recycled forms of mobility and weaponry, and relatively weak national or global forms of governance. There could be 'de-globalisation' as systems hit the buffers and go rapidly into reverse. Corbusier or *Mad Max 2*?

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