Going Past Limits to Growth

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A Report to the Club of Rome EU-Chapter

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Foreword

Why We Should Grow Beyond Economic Growth

Our society owes a lot to economic growth. Growth was – and still is – a dominant driver for the increasing wealth of the nations and many people. Yet, it is more and more being questioned in the face of environmental and social pressures threatening humankind's very survival.

Forty-five years ago The Club of Rome, founded by visionary entrepreneurs and scientists in 1968, hit world headlines by publishing the report *"The Limits to Growth"*. It was based on a new science of dynamic systems at the Massachusetts Institute of Technologies (MIT). Its mathematical model contained the interdependent parameters of population, environmental degradation, depletion of non-renewable resources, food production, industrial pollution.

The report evidenced dreadful trends for humanity if economic growth as then understood was to continue. Needless to say that the concept of limits to growth was unpopular in the euphoric years of rapid material progress, especially after World War II.

Today, the widespread ecological, social, economic and financial imbalances create a climate of anxiety and uncertainty in an ever more complex world. Such a climate calls for new thinking and concepts, leaving the paths of obsolete economic models.

The Club of Rome was deliberately created to obtain a better understanding of the "world problématique", to contribute to new insights based on scientific grounds and to influence policies.

The Club of Rome EU-Chapter (CoR-EU) aims particularly at building bridges with the EU institutions, delivering lectures on a wide range of subjects and organizing special events as a platform for discussion. Among the crucial issues the concept of economic growth was identified as one of the root causes of the overall planetary problems. On 8 March 2017 the CoR-EU organized a debate at the European Parliament with the title *A Different Kind of Growth: Europe taking the lead?*

In the wake of this event several other initiatives, such as working groups on science & policy and on the sustainable development goals (SDG's), were taken. We were fortunate to find among our members a distinguished practitioner in innovation willing to produce a report to the CoR-EU. Patrick Corsi produced a design-based approach for regenerating wealth under the appropriate title of *Going Past Limits To Growth.* We are much indebted towards him, as well as to his publishers ISTE.

Mark DUBRULLE
Ex officio Member of the Club of Rome
President and Executive Director of The Club of Rome EU-Chapter

Acknowledgments

Grenoble, Fall 1976. The multicolored valleys surrounding the city were embracing a myriad of yellowish to reddish shades. A treasure chest from Nature. Backpacking as a student in the mountain chains was like listening to its symphony of colors, seeing its mild windy tunes, smelling the harmonic tastes of freshness.

It was my last year at the then very young ENSIMAG engineering school, the Ecole Nationale Supérieure d'Informatique et Mathématique Appliquées de Grenoble, the latest creation of the Institut National Polytechnique de Grenoble. A place to be that I knew nothing about when applying from… almost nowhere. I had done a lot of math before through a Master's in applied mathematics. And I was still going to do a lot of math here.

Enter a young assistant professor for a one or so weekly hour of course that had no observable program, the content of which was arrows and bubbles written manually on the blackboard. I was listening silently… and telling myself, "*what a strange course; everything seems so easy and so incomprehensible at the same time; so away from differential equations and complicated integrals.*" How surreal this class was, different from all the others. So I enjoyed it even though I was not taking it very seriously. An aggravating factor is that this assistant teacher was speaking (eloquently) over and over again about the Club of Rome, its orientation, its famous 1973

recent book, the need to limit growth and the necessity to see things… systemically. Well, enough for an outer space ride, the semester passed and with it, the arrows and the bubbles.

His name is François Rechenmann – still a professor there – and he was the one who infused me with systemics, by sensing it, by writing it. Well, I should confess that it took me exactly 30 years to see that I had really learned something through his presence… when I began to get interested in complex sciences. Then, his words began to rise back to my consciousness. Gradually, I saw the piece and the pieces much like a Greek drama: planet Earth and Humanity entering in collision. The meteorite was us! Thank you Pr. Rechenman, you did well in alerting us with your fresh baked out-of-space course. This book is a grown up reaction, sprung from your vivid teachings.

To the founding professors of C-K theory at the Centre de Gestion Scientifique of Mines ParisTech – MM, Armand Hatchuel, Benoît Weil and Pascal Le Masson, my sincere thanks for having accepted my recurring questions and myself as a field practitioner applying your deep research every day.

Anna Federighi and your deep inspirational metaphysical orientation helped me deconstruct one mental wall after the other, patiently, which led me to approaches contrasting with traditional academic instruction. The initial model of the “three”, as well as many others, originates from you and many of your own sources. But it took me a good 10 years to understand most of these surprising, totally unexpected yet most basic models that apply every day in human life.

I would also like to pay a special tribute to the person who gave me that special inner confidence to embark into this book. Eleonora Barbieri Masini was right there at the forefront of the initial discussions with Aurelio Peccei, the core founder of the Club of Rome.

It happens I had heard of her several times over the years as she was also a member – long-standing in her case – of the World Futures Studies Federation. I thus took the opportunity to modestly send her a brief 20 pages or so draft that expressed my initial ideas about the 1972 report. It contained a few sketches of another approach, possibly more suited to our post-modern

times made of high complexity and ambient uncertainty everywhere and for everybody.

As I could visit her in Rome during fall 2016 to discuss a few future issues, to my great surprise, she had already taken what was not even a rough outline quite seriously, and had already annotated it with her delicate calligraphy. She then scrutinized it and made further comments.

It's that sort of encounter with people carrying some original vibration that transports you and your mind into another camp: to go ahead whatever the cost at the personal level. Thank you, Gentilissima Eleonora, please receive my full gratitude for your mentoring support.

To each of you this book is dedicated, for it took me meeting each and every one of you to begin to grasp parts of our today's complex world.

And I wish to express my gratitude to my publisher and the admirable team of book producers, for the sustained trust in listening to project ideas and the exact professionalism in bringing these to real books in the market.

There isn't a thing we do separately, isolated – that's so plain an evidence. They're only things that are made by linking up our different, distinct energies. We are unique, yet united. This makes a motto, and makes a world. It doesn't mean being united in a unique thinking way. It means being unique within the rich diversity of one another. It expresses the quality that emanates from each of us.

List of Abbreviations

B2B	Business to Business
C-K	Concept–Knowledge theory
DKCP	Design–Knowledge–Concepts–Propositions
ERP	Enterprise Resource Planning
GDP	Gross Domestic Product
ICT	Information and Communication Technologies
KIA	Knowledge Intensive Activities
KIS	Knowledge Intensive Services
NACE	Statistical Classification of Economic Activities
NPDI	New Product Development & Introduction
OECD	Organization for Economic Co-operation and Development
P2P	Peer to Peer
PLC	Product Life Cycle

PPS	Purchasing Power Standard
R&D	Research and Development
SCM	Supply Chain Management
SCS	Supply Chain Simulator
SITC	Standard International Trade Classification
TIR	Third Industrial Revolution
WWRE	World Wide Retail Exchange
WWW	World Wide Web

PART 1

A Present-Day Imperative

1

A Present-Day Imperative To Think or Not To Think…

> "Society is facing a new and unprecedented challenge–responding to its own overwhelming complexity. The structure of our society must change."
>
> Yaneer BAR-YAM, NECSI

"*Grow, baby, grow.*" Here is a spiraling mantra that resonates in economic and political spheres about infinite growth, jobs sourcing and improving the already set economic indexes.

All right, so it be. But is there somebody listening out there?

The world – the material world – is finite. How then, could mankind sustain such an infinite spiral? At stakes is the way we think it. To think mankind, its role and its ambient effects.

1.1. Where are we by now?

Over the past few centuries, as civilization progressed, it transformed its rooting mechanisms, its governing methods and its intangible orientation. Figure 1.1 sums up the transitions from the 19th Century onwards and the late one from the 20th Century onwards.

Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter, First Edition. Patrick Corsi.

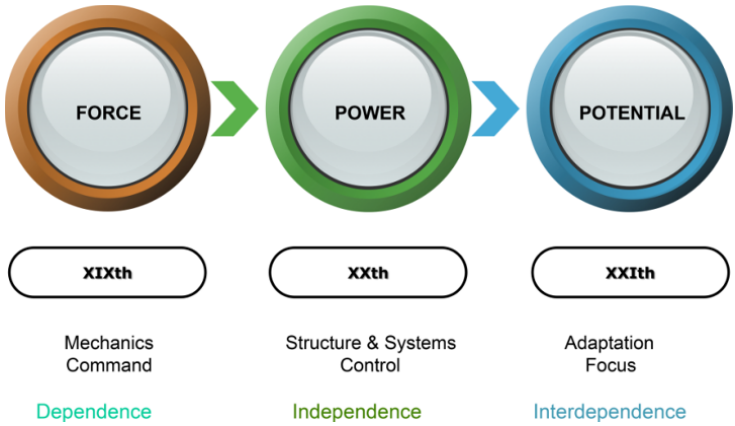

Figure 1.1. *As civilization progressed, it transformed itself profoundly*

The original 1972 Club of Rome report famously illustrated the consequences of the latest evolutionary cycles through a series of curves which, whatever the scenario, ended up being cursed, however with notable variations in lapse time. The plots are recapitulated in Figure 1.2.

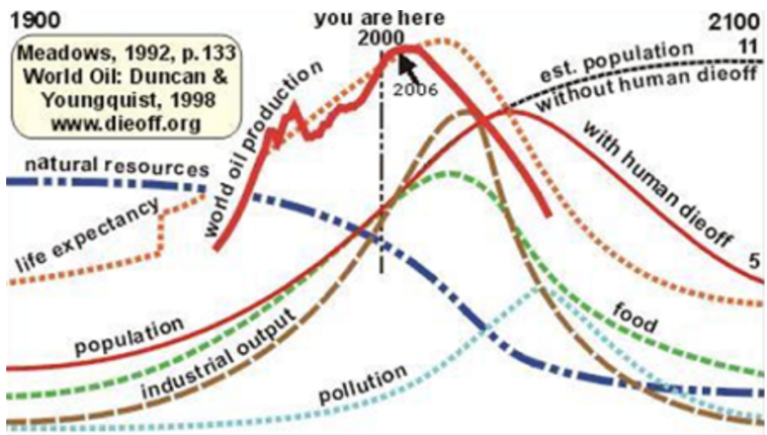

Figure 1.2. *The simulations' outcomes published by the Club of Rome 1972 report were plotted against all odds*

A good half of a century later, and to begin with – let's pause a bit and make a point – where has humanity arrived? Will humanity proceed easily and safely towards such a goal through the present and coming changes? Knowing that these very changes promise to become really exponential within decades.

Our civilization labors strenuously in finding a sustainable sequel to the Industrial Revolution. Albert Einstein famously said, “We cannot solve our problems with the same thinking we used when we created them”, who comes as a poor help anyway.

Even time escapes us: we don’t have the time anymore to run from one part of the planet to another just to meet a few specific individuals. We require technology to supply the faculty to liaise with the many, from the many, and fast. Technology that substitutes us but that also offers the means to work collective consciousness in an instant.

There is a sentient need to rebalance… everything. Us included, probably. But the act and art of rebalancing has not enshrined our constitutions, at any level, it seems. Instead, the way our society functions is to mass employ resources – populations, minerals, whatever. Social capital is at odds.

Should we dare refresh our memory with the very words of the then contemporary UN Secretary General U. Thant, which served as the front introductory citation to the historical 1972 Report for the Club of Rome:

> “I do not wish to seem overdramatic, but I can only conclude from the information that is available to me as Secretary-General, that the Members of the United Nations have perhaps ten years left In which to subordinate their ancient quarrels and launch a global partnership to curb the arms race, to improve the human environment, to defuse the population explosion, and to supply the required momentum to development efforts. If such a global partnership is not forged within the next decade, then I very much fear that the problems I have mentioned will have reached such staggering proportions that they will be beyond our capacity to control”.

These words were written in 1969. How can we push the production frontier in new ways that rebalance the whole lot? It is probably a preparation that day after day works on our consciousness, on the energy quality of our consciousness. But we need to go deep inside to find it. To balance outside, we are to balance ourselves inside. And this in a sense requires reprogramming the way we use our brain. After all, how can we churn out new things with an older software?

To begin, let's make a few critical observations that seem to characterize our 2010's times.

The economic cursor has shifted in recent years. For one, the wealth is ever more concentrated, and the lubricant for distributing it widely is a rarer resource. This is quite clearly a source of unbalance, if only of the economic system.

Education has shifted to mere instruction, that is content. Or information, if we prefer. And at younger ever ages. But offering data deluge isn't a recipe to free the inner/innate potentialities of our children, or is it? How do you address creativity and imagination? How do you train the exploration of fresh, original, varied paths – those that will lead to future innovations? The more developed countries aren't much better in that respect compared to the less developed ones.

Many people suffer depressive states of being under the social pressures they experience. Gaps creep between the social environment and themselves. Perhaps they are demotivated by their jobs, have a poor self-esteem, can't dream a better living. A rampant generational divide may not help: while younger generations are striving and jumping into the future, older ones find it hard to regenerate themselves in a mobile, hyper connected and accelerated society. Inclusiveness becomes harder to achieve as a social objective. Do our children being in their twenties or less have factual past reference based on pre-Internet age models?

And what about ethics, the cornerstone of our civilizational roots? When lacking, we simply collectively loose the societal spinal cord that underpins our societal structures. Social motivation suffers and cohesion disappears.

Yet, at the individual level, the basic balancing act between what I give and what I receive sources the value tone found in any social transaction. To sustain a postural contribution, I would at some point need to see the enlarged value picture that goes forward beyond myself. This in the end builds the global balance. A global poise and steadiness built from our differences! What a paradoxical construction: each of our uniqueness, when assembled together, brings a unity, a sense of belonging, even a feeling of wholeness.

And this also constitutes the "Third Industrial Revolution" (TIR) narrative developed by Jeremy Rifkin which basically says *how the lateral*

power will transform economy, energy, and the world [RIF 11]. A narrative that is based on the convergence of information and communication technologies (ICT), energy and transportation. It is first the Internet of Information that underpins the TIR. Then, an Internet of Energy is now developing through a decentralization of the production. As for the automatization of transportation, this is a current trend via more autonomous vehicles guided by positioning systems.

The Internet alone was and still is a computing-centric network; it thus cannot provide the global solution it is commonly expected to deliver by each of us when using it. Any progress will result from ubiquitous and pervasive access and secured network transactions and not from the possession of connecting devices, as this was brilliantly demonstrated by the visionary Jeremy Rifkin two decades ago [RIF 00].

As we endorse a TIR vision, we can only begin to understand the power of a hyper-connected world sourcing enormous growths via a sharing economy and the collaborative commons. The basic tenet for the new growth power is that every asset – a product, service, data, information, knowledge, know-how, etc. – was previously a "fixed given" and now can become an *enabler* of new values. "*Lateral power*" says Rifkin. The previous motto "Anywhere, anytime, from any device" of the birth of Internet is being radically transformed into:

Anything contributing to anything from anywhere

For instance, any use or building houses a micro energy plant that powers the sharing activities of a local community team which contributes to circular economies involving third communities, which in turn involve etc. The enormous difference in terms of growth potential between the two expressions lies in unleashing the exponential power of the contributive links within networks. Networks fundamentally develop exponential laws[1]. Our world has followed the dominant rule of an *extensive* growth path: more resources, more work force, more inequalities, more debts, more pollution –

1 Metcalfe's Law says that the value in using a network is square the number of its nodes. A geometric progression respective to the number of its nodes. Metcalfe's Law is setting that the value of a network – i.e. the ability to connect nodes from any peer to any peer – grows with and equals half the square number of its nodes. When Metcalfe introduced his law, a node was a device. Today, a node should be a user (after all, a user may connect from mostly any device). This takes us back to the Rifkinian vision of a world of access and not a world of machines.

more is good, more is better, only is more. But we know we have collectively reached limits. Not only to growth, but to everything that has a material correspondence. And that we cannot function as cycles only, such as growth–wars–regrowth or bear market–bull market, because a host of contingent epiphenomena become more impacting than the nominal activity (e.g. population increase, raw resources attrition, traffic congestions, etc.). What then is worth the accumulation of money or any wealth for instance, if taken in isolation? Beware reader, humanity is secretly churning out new fundamental and more inclusive values, which may have such names as creativity, sharing, belonging, cooperation… well, quality it is.

A big transformation is at play that radically transcends the linear model views of the past epochs. It engages into spiraling dynamics based on a huge convergence of means, for which Rifkin uses the term "distributed capitalism". This represents the core *growth foyer*, and human beings may not want to miss the opportunity to reposition themselves collectively at the center of the value processes. Today, it is concentrated, and hierarchical structures that occupy this position, armed with the scaling model. This transformation also entails the reversing of models: a mobile transportation system when not in use may power a fixed installation (it used to be the reverse!), sell and buy energy. Inversions happily unclog the previous accumulations (of energy, of materials, of stocks, of people, etc.). Everything becomes a source (of power, of knowledge…), a tank, a market place, a transporter, a buffer… Just plug anything and… welcome to roadmapping the "ambidextrous society". Everything becomes a lever, and we will formalize a ternary model far extending the public–private partnership (PPP) models and which can operate as a building block for massive growth anywhere, everywhere.

1.2. Situating this book

This book seeks to express a synthetic operation for stimulating a productivity understood in a global way. It specifies the bits, later to become words, sentences, border-crossing narratives of a new open growth-based economy and society. It attempts to cut through a number of commonplace views, fixations, also some cognitive bias about such pervasive notions as growth, work and related notions. The first step towards an ontology of growth.

A specific result will be the consciousness of mental representations in action. Not statistics and not quantitative analyses. We believe mankind has reached a major level of interaction, and therefore the urgent thing is to set things in motion – to begin by the mental side.

The biggest problem that we are individually and collectively facing may not be external to us. It may be that we want to continue ahead and strive, still resolving our most pressing problems, but… we still tend to think with our past models. A global situation that would be funny enough to narrate in cocktail parties if it had not the most severe consequences for our common future.

Why so? Because the discrepancy grown wide between the required changes and our way of thinking of them denotes a capacity gap. That we became incapable to address the salient issues with adapted measures due to our resistance to the old ways of doing. Thinking, speaking and writing, and acting are distinct occupations. By not aligning these three stages, we simply disrupt our future. The unfortunate thing facing us is that our free will compels us to always act; but have we thought well before acting? "Thinking well" is about a method for thinking. And that comes before… thinking.

Thinking how to think isn't taught much at school, and the gap goes on during our whole life as an old vest attempting to cover our acts. Shouldn't it be the opposite? And while speaking of it, when a society has reached a collective level of sophistication, as it is clearly the case today, shouldn't the thinking exerted in society be in terms of the collective and not the individual?

Some could argue that it is science that has reached a high level of sophistication inviting us to abide with what science discovers, invents, programs and develops. And they're surely right: who would reasonably argue the going back to ancient times of living? The problem lies in our dominant analytical approach that tends to restrict our innate perception and discernment. For instance, how capable are we to change scale in our investigations?

At this stage, it seems that the dominant reasoning behind the notion of economy needs to be revisited and new propositions be made which widen a strict economical scope. To make this possible is to found a relation of humans with respect to their environment (economical, ecological, planetary…). In other terms, to neutralize the risk of global ecological

destruction of the planetary resources… But then, is such a shift a mere contingency that is attainable through adaptation, elasticity or flexibility only? Or does it require a massive revamping of the way we do economy? We hold no clear or definitive answer here, and the vast imaginative capacity of man may originate positive surprises.

Our approach may just represent a modest contribution in understanding how to branch out positive paths. Our tenet is to deal with mental models that may source a new economic paradigm. Not solutions *per se*, as the approach would then reduce to a problem-solving approach, while the stakes are a new understanding. Our difference is that we do not seek solutions; we call for opening our understandings for action, so that a new horizon would appear and be shared. This book isn't a macro economy treaty. It is more a narrative anchored on growth mega trends plus a definite method. It is an intellectual framework that engages into walkable forward dynamics.

Many local solutions have appeared here and there on this planet, be they alternative currencies by the thousands, entrepreneurial experiments by agro-food growers across continents, or city-based entrepreneurial systems. Verifiably, they tend to be and remain local. And their scaling up may not result from direct expansion. It could be that the socio-cultural conditions prevailing elsewhere appear to remain hugely different. Perhaps, a consciousness raising will instead abstract the meaning behind each local project and diffuse in wider human mental substrates, then ready to land into myriads of new local implementations. In other terms, not a linear transfer model, but a de-contextualizing phase preceding a re-contextualizing step. Such planetary adoption models are yet unknown to our conscious mind, as this was probably never yet achieved by humanity.

Several mechanisms are already widely shared: the circular economy, the blue economy (developed by Belgian entrepreneur and economist Gunter Pauli and his team [PAU 10]), the shared economy and their varieties. At the moment, technologies such as the blockchain rise to offer radical changes in transactional operations, also in behavior. But to go farther: how to create ways and means for infinite growth? Is this possible, even plausible? What can infinite abundance be? Certainly not material possessions only, as these are necessarily physically limited.

For Thierry Gaudin [GAU 10], "*the deeper question is that economic doctrine has to be completely reshaped to fit the realities of cognitive civilization.*" The fact is that Peter Drucker [DRU 85a, DRU 85b, DRU 93,

DRU 02, DRU 06] long signaled the big change forward to be created by the knowledge economy and its knowledge workers.

Any revolution commences by thinking. We need to theorize somewhat the matter at hand before anything. The central tenet is to offer the means for a deeper investigation of what can be meant by growth and work, not from the point of view of traditional economy, but with a design capacity that opens up fresh avenues. For work is part and parcel of growth, as growth is part and parcel of a thriving economy.

1.3. From local to global to complex

Ugo Bardi [BAR 11, BAR 17] cites and amplifies the famous word by Seneca, who wrote that "*increases are of sluggish growth, but the way to ruin is rapid.*" His point is that, having reached the global level operations – and with global problems on the rise – there isn't an alternative for humanity to jump away to a safe exit (as it was the regular case when regions developed as substitutes one after another). In plain terms, growth as we have known it is simply doomed. He recalls the early "World3" model used for "The Limits to Growth" study in 1972, which was the first ever to consider the world's economy as a whole, with this figure:

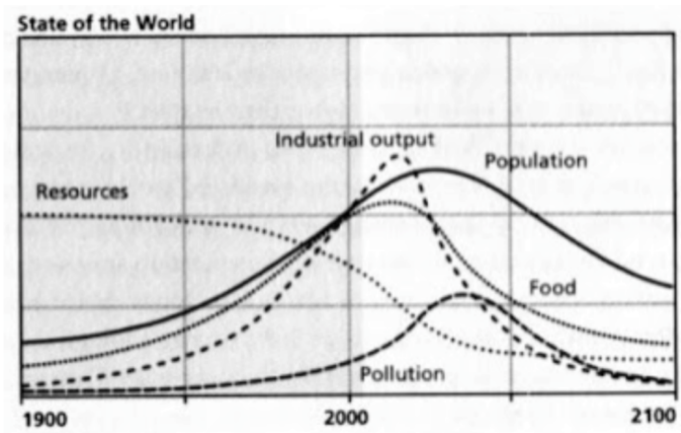

Figure 1.3. *The "base case" scenario late 2004 study from the Club of Rome (cited by Ugo Bardi, [BAR 11, BAR 17]), where the Seneca effect (forward leaning curves) was already observable*

Thanks to system dynamics, Bardi has shown that the persistent pollution factor alone can create the Seneca effect: in a sense, it is a spin off effect from a nominal capital that at some point begins to drain this very capital. And he concludes, "*In all cases, the Seneca effect will be the result of trying hard to keep things running as usual.*" That is why this book departs from the business as the usual mindset and tries to operate a "mind range"[2] exercise geared to open up fresh avenues for developments that not only cut through the current mental fixations but also venture into unknown territories.

But are we truly in a knowledge-based economy? For Gaudin [GAU 10], the word "cognitive" is preferred to the classical "knowledge-based economy" mantra for the reason it bears an interesting assumption. That, as first quoted by Alvin Toffler, hyper choice and cognitive saturation appear as two specific features in this civilization, which faces the "industrialization of the persuasion activities".

The conventional narratives bathing us are social, cultural and environmental, and their voiced themes are themes of a new Industrial Revolution: smart economy, prosumers and social model, energy, mobility, finance, circular economy, food, etc. As we become all connected, we no longer dwell in a knowledge-based economy; we are the knowledge, we become a fictional family in history (quoting Jeremy Rifkin), adoring smartness in every object.

And this is the positive narrative. However…

There's another side to the coin. Are we managing our nations and collective bodies in a way that – by the same token – becomes detrimental to us collectively? Do we have to wait for the negative impacts to become so evident that action becomes mandatory if not just too late for survival?

We all remember Al Gore's two canaries in the coal mine, Arctic and Antarctic, which lurk around us now: "*We are witnessing a collision between our civilization and the Earth*" (from: "An Inconvenient Truth" documentary). Whereby three factors (growing overall population, technology bigger than human scale and way of thinking) are our factors forming our relationship to the Earth. Sustainability calls for a new science of qualities (not quantities!) and a higher system for adopting it. Accounting

2 This term is intended to echo and also transcend Seymour Paper's "Mind Sized" epithet [PAP 80].

for these a new *language* is required that will support a new perception of reality. And this leads to consciousness.

To reach consciousness levels, we asserted in Massotte and Corsi [MAS 15a, MAS 15b] that the "*sustainability of a system is based on the five following and complementary codes:*

1) The code of Matter: which is the source of any aggregation, growth, gravitation, now subject to *quantum physics*.

2) The code of Life: with the *DNA* biology, etc.

3) The code of Thought: with the *brain*, its capability to reason and to develop consciousness.

4) The code of Energy: with thermodynamic physics, i.e. entropy, etc.

5) The code of Complexity with the new geometries (chaos and fractals) and *Network Theory*, etc."

These five realms of organization act in conjunction. Sustainability is the result of finding new equilibria in the five codes constellation, and a new vocabulary is needed. We added: "*These five codes reveal different aspects of Sustainability. They are strongly linked to some of underpinning concepts related to information, information systems and decision-making, notions of space-time, quantum fluctuations, entropy, etc. Also, we have to point out that they are interdependent and involve each other, e.g. matter and energy for positioning in space and time, etc.*" Figure 1.4 synthesizes the five codes into a global whole.

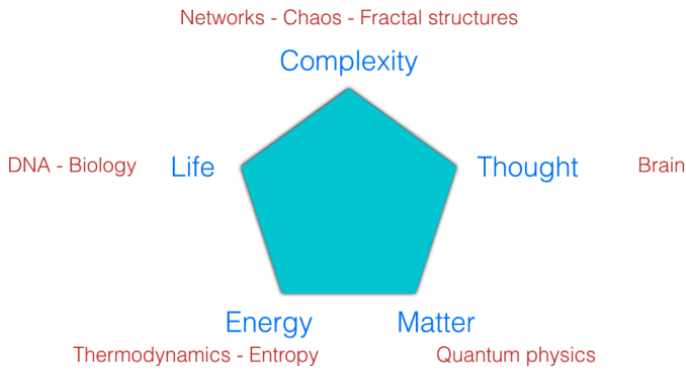

Figure 1.4. *The five complementary codes building into sustainability (adapted from [MAS 15a, MAS 15b]).*

1.4. In search for growth

Traditional capitalism would seek to restore growth through, e.g. the efficiency of the production machine (a "doing more with less" to become "doing better with less"). Today, thanks to the pervasive digitalization of human activities, acting at near-zero marginal cost has become possible in more and more sectors of industry: the cost of producing extra goods is freed from fixed costs. Here we have collectively obtained a new posture that far transcends the traditional mechanical conception of growth, because it potentially enables exponential gains in productivity. Anybody can become a producer of value goods in the above five code ranges: from e.g. own energy to ideas, information and knowledge, to 3D-printed material goods, artistic creations, living, etc., and share it across wide networks, bypassing the classical market mechanisms. These goods transcend the virtual domain to also regenerate the material world.

The radically new business models that emerge are forcefully disruptive. A car previously owned by exclusion and disposed of is now shared, assigned as taxi in the open, reused and recycled. Resisting the new operation models is by and large logically doomed to fail sooner or later because the higher level of complexity reached by our society requires the multiplication of lateral – not vertical – associations of people and objects. This is the age of networks. The capacity to link up (what Jeremy Rifkin calls "access") becomes the core competence for everyone. And in the social capital realm, growth seems to have intrinsic (i.e. material) limit, being a manifestation of servicing attitudes that spiral up into wider and wider settings.

Google's Eric Schmidt addressed employees at a weekly meeting in Mountain View on January 26, 2016 with these blunt terms: "*I can tell you that the tone of this government is very much economic growth*" (BuzzFeed News) and added "*... the core focus is going to be to get the growth rate in the country – which is roughly one and a half to two percent – up another point by simply pushing through increases in federal spending...*".

Would you then resort to accounting such an economy by means of the emblematic welfare benchmark figure of GDP? While the classical economy sees consumers and markets, the new economy – the one of sharing and circulating without limits – enables ambivalent prosumers: combinations of producers and consumers.

Prosumers create a new growth, where not only is more yield done with fewer resources (a degree of efficiency), but better overall value is achieved by sharing and circulating more. Individual prosumers together generate global behavioral approaches which are poised to tackle the post-modern conundrum of economy, finance and environment mix.

Economy and the preservation of the environment are still often perceived as antagonistic. But this is a prevalent dualistic view stemming from past epochs. As we convoke more global views of the universe in which we live, the more alignment we tend to bring between environment and socio-economic development. Perhaps the biggest stumbling block keeping us in dualistic thinking (oppositions, contrasts, benchmarking attitude and comparisons, etc.) is the dominant analytical mindset over society today. Meaning rather emerges from synthesis or the opening up to wider understandings. This is a capacity of resonance, a bit like breathing: you embrace the issue in as ample as possible space and nurture a sense of wholeness.

Without grasping wholeness in your economic models, issues such as malnutrition, poverty – and un-growth – are here to stay. Denis de Rougemont [DER 77] long asked whether a partial approach would suffice. He pointed at the capacity of machines (robots, software algorithms) to address the environment, economy, finance and complexity concurrently: a terrorist's killer robot, a carbon tax in a pollute-pay scheme. Todd Hixon [HIX 16] bluntly declares that "*software has now won a place at the main economic banquet table. It will be able to take on an increasing range of tasks that have previously been the province of humans.*"

Complexity sciences called to the human rescue… Which may help to view diversification as a form of resilience and not of weakness. A political message lies underneath: how to cohere sovereign entities? Ambivalence is what's required to evolve a system where adaptations are continuous and endless because equilibria are sought at any time.

1.5. On futures and their values

Well-known futurist Wendell Bell detects an interesting weakness comment on "Limits to Growth" report: "*While the Limits authors' spent much time and effort on organizing the data, equations, computations, and*

presentations focused on the various scenarios, they failed to justify or defend their values – sufficiency, innovation, development, etc. – as being worthy goals" [BEL 01]. Bell is known to describe practical strategies for reaching judgments about our futures. For instance, how to decide what is "dutiful, right, good, and preferable". "*These include appeals to religion, appeals to law, appeals to collective judgments of group members, and finally, through a set of professional ethics*" [BEL 97].

To reinvent our society is to rethink it. And this will be done in the context prevailing today: Internet age, networked individuals, omnipresent technology, environmental and social responsibility, etc. Degrowth – forced or intentional – isn't an option, and Bardi [BAR 14] cites several reasons why this can't work: poor shared understanding or poor visibility of the regrowth notion, plus savings here that are typically used elsewhere. Then, what could re-growth mean, that not only offsets the Seneca effect, but cleanses the economy from its thermodynamic consequential effects?

By thinking upon this, we think of a mental bridge that serves as a transponder process to facilitate the thinking transformation. The other edge to reach is a widened dimension with less person-centric resistance and more collaborations. The best collaborations, which are those interactions between energies with a common end, for the common good. Which facilitate human resources in their sharing.

Today builds tomorrow, and tomorrow builds another tomorrow, and so on. But the initial propulsion and its correct angle is entirely determined by the posture we hold today – not tomorrow. Should we succeed in staying in this disposition, the present shall become both past and future.

"*Think well to the end. Consider the end first.*"

Leonardo da Vinci's notebooks.

2

Situating Growth in Time–Space

> "Society is facing a new and unprecedented challenge–responding to its own overwhelming complexity. The structure of our society must change."
>
> Yaneer BAR-YAM, NECSI

2.1. Two six thousand day lapses

"*Futurology should anticipate what puts our future at risk*" wrote Denis de Rougemont [DER 77], and he added "*this is what the Club of Rome did in an exemplary way*". His point was to clarify the distinction between a futures discipline servicing man or servicing something else (e.g. state strategies).

More than six thousand days have elapsed since the onset of the present century. An amount of time that is about as long as that from Aurelio Peccei's last spiritual testament in March 1984 to the end of the past century. The symbolic symmetry of these two time periods, pivoting around and spanning equally over both sides of the turn of the century, is actually bearing a heavy, perhaps dreadful, course for humanity. Why so?

First, throughout his time, Peccei insisted on "*the prevailing ignorance of the times*." More precisely, quoting him from a 1979 statement:

> "*the dominant cultural thinking privileges detailed analyses, which flood one with information, forgetting that only a desire for synthesis*

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> *allows one to translate all this information into true and proper knowledge, and a source for wisdom*"
>
> (cited by E. Barbieri Masini [BAR 06]).

In fact, in a unique 1973 striking vision, the Club of Rome had hit maximum global attention by warning the world about the irreversible planetary damage of uncontrolled growth. For the first time ever in the history of mankind, a global concern was posted and addressed to humanity; it was since then bound to become that very original signature and stable identity of the Club of Rome, granting it astounding global success for several decades to come. It was a platform of individual energies that, notwithstanding the interest and pleasure to physically meet, acted almost… energetically, thanks to the intensity of the complementary and visionary minds it gathered to address the many problematics and through the diversity of its constituting individuals. Its global energy was comprehensive of the energies of the individuals who together amplified them.

Unfortunately, Peccei's "*prevailing ignorance of the times*" may have been quite true, as the message received by the Main Street was more or less that "*the Club of Rome is against growth!*" What a fateful counter-meaning, introducing a discrepant judgment for something that was never said.

Second, the world experienced by humans has much evolved since the seventies, albeit precisely in the warning directions signaled by the report: environmental issues became more pressing, economies more often constrained and chaotic, and societies struggled ever more in the face of severely complex issues to tackle. As a result, the acute and penetrating vision of Peccei and his group has by now become all too evident by today's well-shared perception.

Actually, a dominant thinking of our present times even considerably magnifies Peccei's original statement by considering the massive subjugation of individuals and organizations to information-based societal operation and way of living. However, quite paradoxically, this dominance of information seems so banal that it could hardly succeed in drawing fresh and critical attention. A traditional Matter-Space-Time trilogy (for instance in the economic context: products/services-distribution/structures-lead times/timings) must today be reinterpreted in light of Information and Energy. The "hardware" traditionally constituting the notion of Growth must be overhauled and regenerated into "in-formed-matter" and "software"; a major shift we will decisively begin to implement through this book.

A recent report[1] emphasizes "*that the main focus of Limits to Growth was the increasing physical impact of economic growth, not growth itself*". Truly, the consciousness of growth itself may not have been as intense as it is today. And the main change since the advent of the seminal report can be expressed in this simple way:

– in the early seventies, the by-consequences of economic growth could have been considered at best rather marginal to the growth phenomenon. Namely, resource depletion, ecological footprint, Earth-based feedback loops like climate change or tellurian disruptions, etc.;

– in the 2010s, this is no longer the case, and a sense of irreversibility of the trends begins to prevail. We are either currently at peak oil or it has passed, marking a time of harder and harder exploitation, and other mineral resources, including rare metals, are more fiercely hunted by global powers. An Earth overshoot situation is now an old fact.

So, is the famous but long gone 1973 report old hat? Not the least: society hasn't made it endogenous yet! Furthermore, by not changing the parameters, the discrepancy goes on. An inversion mechanism could even soon strike by which one unit of economic action is stifled by more than one unit of economic global counter-reaction. Up to a point when the cost of buying (more) time becomes impossible to acquire, to bear, even to consider.

2.2. Complexity to the fore

The intrinsic difficulty of the exercise is that a correct model would by today's data be hyper-complex, with very many feedback loops and second and higher order dynamics, which may not receive appropriate models yet. Let's face it, we don't have such models; plus, we can only test them with historical data, which by construction embed a *lesser complexity* level!

One aspect of this rising complexity is that problems get intermingled. A policy maker here and another there may have different priorities and justifications, while the issue is one and it is… systemic! Society works sector-wise; disciplines are often siloed as… disciplines. At the moment, it still takes more than half a lifetime for an individual to begin to be familiar with nonlinear phenomena in life, as these can't be seen in the face. Plus, no

1 http://www.clubofrome.org/wp-content/uploads/2016/03/The-Circular-Economy-and-Benefits-for-Society.pdf

disentanglement and no easy decoupling of intricate situations can be made uniformly. Systems science and complex systems science, although half a century old or so, aren't well mutualized across society… to say the least. To compromise our willingness, when beginning to learn about complex systems and their effects in and around us, we unavoidably begin to assimilate the value of cooperation, and less… competition as we know it! Nature seems to actuate a better balance than humans in that respect in its own way.

It appears less important to quantify the when and how much than to grasp the essence of such workings. The reason is that a correct mental model must be achieved soon to restore a proper global functioning in which we, as humans, dwell and operate. Unfortunately, the individuals who understand the life-supporting systems on planet Earth tend to be distinct – by education and operations – from those who deal with economics, politics and society at large. An inherent gap in the population that prevents it from tackling the issues in coherent, coordinated and integrated ways – the complex way.

An obvious fact is that national political powers being designed and implemented in linear ways are far too slow to directly act upon the complex mechanisms. Not mentioning either the several official communities of nations – sharp or loose – which have to go by even more complex decision-making procedures, or the huge disparity in efficiency gains they develop across the world.

Education is generally regarded as the nominal channel for restoring a viable operations mode; however, two eternal questions remain:

– who can correctly educate and

– how to educate (and not necessarily teach)?

For it isn't a content-based discipline full of facts and figures that provokes a change in behavior, but a different way of thinking… the change. It's a change in economic philosophy. Many reports invoke behavioral change, but they generally fail in explicating… what underpins behavior. Education? Way of thinking? Priorities in life? Values? Fashion? Obsolescence? Moreover, while some regions do change, other may still go on aggravating ambient conditions respective to "growth issues"…

The frequent rebound effect situation is that, when some people decide for instance to "go green", it arithmetically makes space for others to "let it go not green"; e.g. you and your community decide to use only two-wheel cycles for city transportation, thus theoretically contributing to less CO_2 emissions, etc. At some point, some vague difference becomes discernible by some majority: with less cars clogging the city, it's therefore an opportunistic time to use cars more intensively! And so, more drivers add to the traffic. Sharing along with the bicycles… What can cyclists do then? It is not certain that a price or tax increase policy will mitigate the rebound effect, less neutralize it. Pollution tags for cars were introduced and enforced in Paris in Winter 2016, yet their net impact in cleaning the streets' air is still at best unsure in practice.

But these are views in zero-sum games, another consequence of dualistic views. Which means, should a positive measure be taken up, it should be global for two reasons:

– to prevent counter effects by other measures or conditions and

– to create accelerated returns.

Conversely, if a negative measure is considered, it should be local for two symmetric motives:

– to not stifle positive measures and

– to not create decelerated returns.

Which world organization is nominally positioned to enforce these two meta-rules to all countries and jurisdictions, including multi-national organizations (companies and other institutions)? A legal framework that would impose a degree of subsidiarity doesn't exist. Yet, such a body would naturally have to abide with democratic governance and control.

2.3. The message is not the content

Given the aggravation factors observed through the years passed by, we sense the time is ripe for the Club of Rome to faithfully reinterpret its original vision in light of the 21st Century determinants. In a nutshell, the next steps for a safe evolution of humanity will likely lie in its ability, not only to limit as was said before, but to radically define growth differently in light of the new socio-

environmental determinants. And therefore to find a way to avoid the pressing issues that doesn't expose neither humanity nor its global environment.

The aftermath of the publication of the 1972 report doesn't seem to have progressed through the complete moral competence model of psychiatrist Elizabeth Kübler-Ross. Her model (Figure 2.1) known as the five stages of grief after a shock or a surprise reads:

denial (and frustration) → anger → bargaining → depression → acceptance

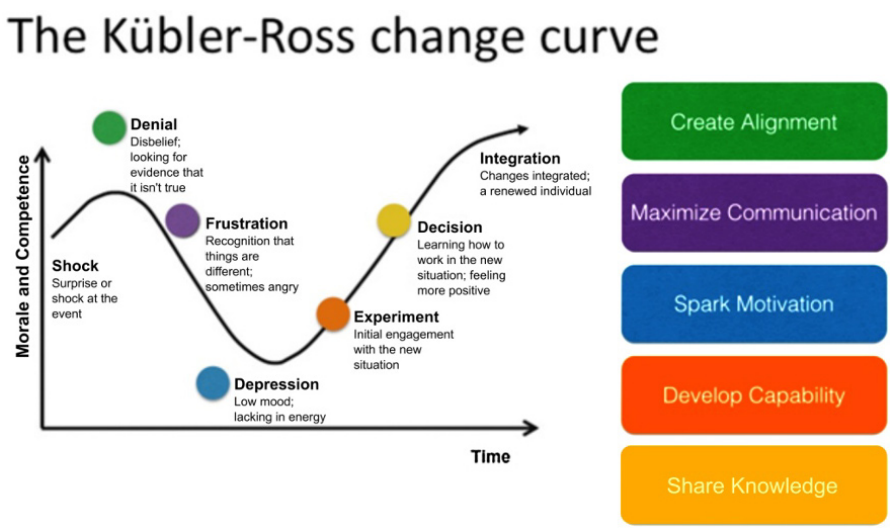

Figure 2.1. *The Kübler-Ross change curve: how accelerating the progressing through the curve would certainly help – https://www.linkedin.com/pulse/kubler-ross-model-mohamed-ibrahim-bpharm-m-mba*

By the way, what could a contrary to growth be? Is it de-growth, a decrease in growth volume, or dynamics? Is it backing off from economic progress? Loss of wealth? Unprofitability, underdevelopment? Or perhaps controlled growth. This book in part seeks other designing avenues for growth, and hence the need for a suitable framework, the investigation of other types of growth, its relation to sustainability, the ways to stimulate wealth in contemporary contexts, etc.

In the past, wealth was measured by the abundance of grain. What if a crop season wasn't yielding enough wealth? Fear of bad weather and rituals in ancestral civilizations were meant to palliate the risk. What about fearing growth nowadays? There are reasons for it. This frame opens up a "growth fear" tree.

Fear of growth:

– from commoditizing revenue streams;

– from AI-enabled economy;

- automate knowledge;

- robotics;

- blockchain;

- FinTech;

- InsureTech;

- Medtech;

- expertise;

- advice-based sectors such as accountancy;

– from too much speed, power, scope and capability of AI;

– losing out to technology providers;

– depersonalization;

– loss of professional roles.

Which is rather worrying, for that singular report, despite its far reach and dissemination, may not have been understood in essence: a humanity still in denial wants to go on with an economy as usual ("it isn't happening! No help wanted"). The important and urgent question is perhaps what new competence can we build to circumvent the process to show the way out in psychological terms? Yet we also need a method, and it is the purpose of this book to offer the first steps. The science of anticipation is burgeoning, but is still too young to offer solid guidance in these pressing times.

An inward change of mindset generating breakthroughs externally is what we opt for. To operate so, we will call for a validated approach called C-K

theory (see Appendix 1). One of our first steps will be the minute breaking down of fixation points in the thinking surrounding growth and the economy, probably one of the first times that this has been attempted. It may well be argued that time lapse has become too stringent to reverse the curves that are dooming the economy's substrate: mineral resources extraction or educating a new generation (with which professors?), or even to engage in activism. And, due to the change in entrenched habits, the risk of opposition or strong reaction to forcing positive behaviors should not be neglected.

As we are in a mentally intense epoch of civilization development, perhaps a better way is to go with provable and reasoned means. We therefore prefer to implement a radical design-thinking approach by which we force the design of positive outcomes with sought-for properties. This has been often implemented in industry and institutions as well. Why not apply it to the more global issue of the economy somehow?

This approach isn't, nor shouldn't necessarily be, a quest for a new substituting vision, as the 1973 premises appear even more relevant than ever. It should however be seen as a new and complementary reasoned way, able to source new growth potentials, to channel new technological developments, to investigate fresh economic avenues, and to maintain a harmonious conception systemically linking man, society, machines and technology, within the surrounding global environment, at all levels. How about such a rational complement?

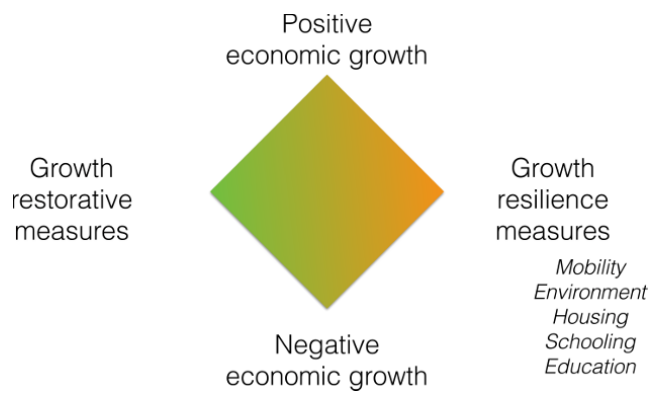

Figure 2.2. *A growth compass just to begin a defixing process.*

Can the design of such hopeful growth methods become possible thanks to the availability of some new models and tools? Can the latter possibly resort to a capacity to design futures in unknown territories?

Let's recall the five interdependent parameters considered in the 1973 report, namely Population, Environmental degradation, depletion of non-renewable Resources, Industrialization, and Food (abbreviated as PERIF). Do they still represent the correct and only ones to tackle the bundle of pressing issues faced by both humanity and the planet today? Not only for trying to avoid damages to the planet and to society at large, but also to the people, individually and to their collective systems, the economy included. Presumably, this extended quest remains uncharted and inescapably extends the scope of several former reports to the Club of Rome (see references in Appendix 2).

2.4. On the approach taken by this book

By deliberately taking a design-based approach, we opt to take a step back from the dominant models, away from specialty models that are too often difficult to put into wide use. Changing paradigm is easier said than done and until our own personal energy is thrown into the game, that remains… words, habits perdure, nothing important changes.

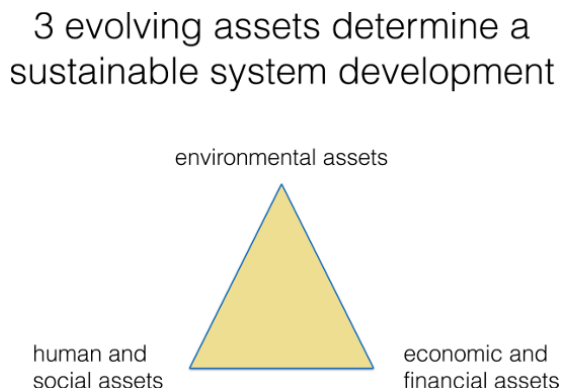

Figure 2.3. *The components of a sustainable development.*

This book displaces the issue at hand ("growth"). It positions the reader to interact with complexity science, helps characterize and manage

complexity, which today is an indispensable component to studies being carried out in many sectors and across many domains, including biology, industry, sociology or governance, etc.

More distinctively, it offers a methodological approach to engineer what is complex through a design-based approach, as this unique approach can offer pragmatic and usable tools in the field, across cultures and organizations. Performing innovative design experiments in any socio-economic field and analyzing the results would valuably complement this book.

By quoting author Peter Drucker, Gaudin recalls an irrevocable pulse of civilization [GAU 10] that we tend to forget at mere generational level:

> "*Every few hundred years in Western history there occurs a sharp transformation. Within a few short decades, society rearranges itself; its worldview (paradigm), its basic values, its social and political structures, its arts, its key institutions. Fifty years later there is a new world.*"

For sustainability of success, humans need be aligned with the environment through their economic ventures (Figure 2.3).

We believe such a dynamic change comes of age through deep structural change, a form of radical societal innovation. A number of feminist economy authors have long led the way: Marylin Waring, a former New Zealand politician, demonstrated in her book *If Women Counted* [WAR 88] "*how the unpaid work traditionally done by women has been made invisible within national accounting systems, and the damage this causes*"[2] and articulated a grass root critique of the national accounts system. Interestingly, she already included the value of Nature in what counts for measuring economic growth.

Yet, lighting the way through a paradigmatic change is no easy task; it entails a new consciousness, leading to a new culture, rather a trial in the midst of uncertainty, rampant doubt and sheer perplexity with which we struggle. But one thing is sure, that for the sake of life, the goal is above all thriving on the journey itself. May this book place a few nuggets along this path that can ensure the safe taking of a few more directional steps forward.

2 https://en.wikipedia.org/wiki/If_Women_Counted

3

Dominant Thinkings of the Past Century

> "Unlimited economic growth has the marvelous quality of stilling discontent while maintaining privilege, a fact that has not gone unnoticed among liberal economists."
>
> Noam CHOMSKY

3.1. Economic dynamics evolved

Growth is a short word for expressing economic dynamics. This notion shouldn't be considered in isolation, but as the dynamics of the interplay of four main categories (Figure 3.1).

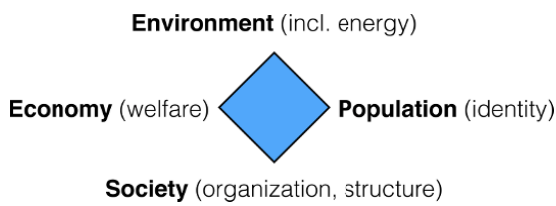

Figure 3.1. *The four basic SEPE quadrants covering a notion of growth*

Many authors, of whom many are economists, came into play to study the links between the discipline of economics, growth, markets and innovation. Throughout the 20th Century, models were elaborated and evolved, which involved parameters such as labor, production, capital, savings and saving rate, capital output ratio and population growth rate. Some parameters were sometimes treated as exogenous and uncontrollable (e.g. technical progress,

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human capital, etc.), to be internalized later e.g. innovation and technology, as they were deemed to impact growth. An interesting historical account summary is found in [LEM 10].

Scholars were actively searching for optimal growth conditions, and the dynamic programming techniques that appeared around the sixties were put to use in helping to design policies for state planning. A general shift towards "defining frameworks for economic policies to favor continued, balanced growth" [LEM 10] was epitomized in studying the role of competition, macro-economic policies, etc.

Today, however, the situation doesn't stabilize at all. A strong de-correlation between the level of R&D investments and the perceived performance of firms was stunningly shown by a famous study by Booz Allen and Hamilton, repeated yearly since 2010. R&D intensity (defined as the R&D expenditure expressed as a percentage of GDP) comes as relative to GDP, hence misses the focus capacity (which saves expenses, lowers risks and may improve timings).

And the chief role of innovation as a continued driver of growth is widely accepted. Growth by breaking status quo, making market breakthroughs and regenerating strategic market spaces. All in all, does it seem that an elusive growth notion stands on conceptual quicksand and escapes a definitive definitional grasp? Is it that the subsequent definitional phases entail a growing understanding from our part instead?

3.2. Change and no change: the art of governance

When Peter Drucker signals an irrevocable change at society level every few centuries, he evidently points at two joint processes and not simply one:

– that each phase needs establishing characteristic reference points that will define its stability and

– their reference points however need to be altered in depth or even disappear to allow for the following phase to install its own, fresh and new characteristics.

In other terms, a given phase sweeps away its previous one or doesn't come of age. It is a generic law of nature, and it applies in the innovation world too. What interests us here is the set of crystallizations that sediment

in phase and at some point become the locks for the advent of the following one. We see this at a smaller scale in industry: the definition of a product which lasts too long becomes a laggard, preventing other changes to happen. This causes companies to be disrupted by competitors.

We have a name for these entrenched characteristics, assumptions, sedimented habits, fossilized structures: "dominant designs" (DDs). They reveal dominant usages, by which everybody goes by the agreed rules. They're like a "no change" zone, a dead angle obscured in consciousness. Only ruptures from innovative forces may alter their build up. After all, all economic sectors are gradually grown from such organized ways and habits which make up their dominant characteristics, their signature.

3.3. What's in a "dominant design"? [COR 15]

The practice of identifying, defining and then breaking DDs roots the art of breakthrough innovation in industry and elsewhere, including in arts and civil crafts. Marketed objects[1] are bound to a structuring reference for organizing trade: the design is shared by players, including competitors; markets are rather mature[2]:

> "*The value of objects can be assessed, products forms are endorsed by competitors, knowledge can be accumulated, and all changes followed on. One virtue of a dominant design is to simplify the offer-demand relationship. Incremental innovation may be performed to sustain a dominant design. In the end, dominant designs evolve to the point of sheer complexity, hence may call for self alteration; then, new dynamics emerge that break dominant designs down.*"

The notion of DDs traces back to Utterback and Abernathy [UTT 75, ABE 78, UTT 94]. Industry hence typically operates by favoring a relatively stable categorization of products, market segments, players, etc. and even ecosystems. This has evident advantages: competition can be set, organized

1 The word "object" will be understood in a general way: a product, service, actually anything that can be subject to innovating, i.e. altering its "identity".
2 From Blanchard & Corsi [BLA 13]. First steps in fielding C-K theory, Apple Store. See Bibliographical references at the end of book.

and strive for success. By doing so, its means of action make key market assumptions:

– objects' identities are as stable as possible: functionality and performance can be referred to;

– delegation can be organized (supply chains, research, development, etc.) and specialized departments become in charge of a key dimension of the work;

– then, planning is based on linear models, which are bound to predictive and other statistical analysis approaches;

– and, finally, the classical management models with respect to objectives can operate, also by using the many well-known methods, techniques and tools such as market and value analysis, portfolio management, change management, business process re-engineering, etc.

However, can the above be a safe harbor for long? Are products really permanent? It is the quintessential function of innovation to alter a status quo. Of course, innovation can create a roller coaster game both for the clients (who then have to re-learn about products and usages) and the competitors (who can't rest assured on agreed market grounds safely shared by all). Innovation is a catalyst that, when regulated with care, transforms the entire industry domains with no possible return, ever. As soon as innovation forces drive the competition, the above assumptions and model of industrial activity gradually lose their validity:

– object identities are altered continuously, without an *a priori* commonly agreed plan, stifling the stable references the industry was building from;

– specialized departments need to intertwine their operations deeper and deeper as, for example, R&D can no longer be distinct from marketing;

– statistics become insufficient to feed the plans and methods, which shift from reactive to proactive, even anticipative;

– and, finally, the organization can no longer be managed "incrementally" based on the identified resources, bound to fixed objectives, and on fixed division of labor.

When innovation becomes intensively called forth, the traditional settings of industry not only lose their value but represent, as time goes on, an impediment to become dynamically agile, and to regenerate itself at times. If

flexibility shall rule, it would be at the expense of rigidities everywhere: structural (hierarchies and commandment), organizational (competences, procedures, etc.) and operational (from R&D to markets...and back).

What would an industry breaker do? The method is simple to explain:

– Accept the industry's DD and understand where they come from. You can't fool them all anyway, but by understanding where they originate from, you gain a key to an exit door. For instance, by realizing "banking is important, banks are not" (a famous old quote from Bill Gates), you wouldn't position banks at the center of a business ecosystem much longer when dealing with billing procedures. You would rather attempt to understand why banks were created and for which original functions; focus on the transaction act itself and secure this passage. You would possibly end up designing a blockchain technology. Banks as we've known them become de facto contingencies, which is potentially revolutionary.

– Locate a few of them and dig out their functioning. Here you scope each DD: is it optional, who controls it, do alternatives exist, etc.?

– Find one or more points-of-break and open the DD right there. Breaking a DD is the door to venturing into the unknown. By removing the locks that express anterior compromised methods and solutions, entire avenues of new possibilities can see the light of day as long as the new choices are sound, a thing no market analysis can prove to you nor can it prove that it remains impossible. The postulated choices are but undecidable at this stage. Those who dare to venture through may be rewarded with surprisingly successful bets. The trick will be to express the DDs in a way in which they can be broken to explore what it would then mean for the product. After which, rupture axes need to be defined and explored.

– Later, intentionally create DD regimes. Here enters the notion of lineage ([LEM 10] – "a matching of key competencies and product families") whereby new knowledge is created, a product's lineage is created by reusing this knowledge, and hybridization follows which aims to explore all possible strategic market spaces corresponding to that new knowledge. This leads far from offer and demand, market saturation first principles or market erosion phenomena. When lineages prevail, the firm cannot preserve its past hierarchies and organizational methods, but becomes more and more of a "swarm" organization, dwelling into complexities at every stage of its operations. It becomes a master at monitoring DDs' life cycles. As DDs in lineages follow classical S-shaped curves (slow growth first, then high growth, followed by slow growth at high output [LEM 10]), the industry

regenerates a traditional pattern of mature industries anchored on their DDs. These companies which have a "revolutionary" DNA cannot be content with this fate and will compulsively prefer to enter a radically new game, by again, breaking yet another DD. We wrote about Apple's DNA and the ability of this company to break away from the DDs of their competitors [COR 16]: here we have a company having played growth at a high proficiency level through several phases of its nearly half century long history; a compulsory evolutionary destiny of a born catalyst.

3.4. Why are dominant designs important to consider?

A DD is important to us for two reasons:

– Being built and coalesced from history, DDs don't reveal the reasons behind the choices that were made to contribute to their construction; these are obscured by the sands of time, hidden behind routine usage, normality and risk avoidance. They're building our common sense: for instance, if something seems to work, why change it? Who wants to take the risk to alter a process that runs satisfactorily? Well, apparently satisfactorily, as it also prevents the invisible quantum steps that would offer significant advantages for those abiding with it. At the cost of a rupture, that is the "problem".

– To break a DD, we need good reasons, and finding them is generally going to require going back in time to the birth moment when some specific choices were made that were instrumental in building the DD we observe today. Deconstructing a DD therefore requires an understanding of the motivation underneath which was buried by usage and time. The problem is that the good choices of one epoch may be the hurdles at some later time when contextual conditions have evolved.

Which amounts to saying that the art of regulating the trade-off between:

1) keeping the status quo under the often growing surrounding pressure and

2) cracking a DD for a new construct at the cost of disrupting the way things are,

is the art of the policy maker, of the innovator, of the governance. And the ideal criteria for exercising it should be the superior interest of the organization: the firm, the institution, the nation, the collective – the well-functioning of the target entity at stake.

3.5. Operating dominant designs on an example

As for practicing through an example, we will apply the concept to economic growth. It is a well-known fact that growth has, for a very long time, been founded on a debt economy. Debt is an ever growing phenomenon, with such a rate that economic growth is for many nations nowadays a pale comparison, often being closer to stagnation than to true growth. Understanding growth hence is first about understanding debt (one DD).

The situation has become coarser, revealing other anterior incident factors. The first problem is that, with the higher and higher capacity of modern industry, natural resources (which aren't infinite) become exhausted, and planet Earth's life balance is at stake. Yet, markets are organized in such a way as to not represent prices: they typically do not reflect an "ecological truth" (DD: market price marks are de-correlated from global truth). Then, the prioritization of the short-term and not the longer-term measures yielding profits de-possesses future studies and investment efforts from virtuous restorative values. How is it possible privilege long-term perspectives capable of stirring evolution in harmonious ways (collaborative or shared economy, circular economy, blue economy, etc.)? (DD: exacerbate local and short-term profit through the narrowing of pricing asset).

What about costs for the firm? As the linear economy lacks feedback, the costs of operating a business are also accounted from a reduced asset which excludes negative environmental and social factors. On the whole, the cost-to-price ratio is locked in a quite restrictive accounting. (DD: accounting leaves externalities either evacuated or opaque.)

Another problem is that the development of technology (i.e. the robotization of industry and to some extent the mechanization of society with the activated capacity of artificial intelligence) gradually shifts human work, as it is known, to a subsidiary activity and status. Work is being shifted to machines for productivity; then, competitiveness with a double-edge effect:

1) automatizing the work tends to reinforce the previous two DDs of the economy by enhancing productivity and shielding from externalities;

and following 1),

2) there are cumulative effects further enforcing the previous market mechanisms, this time with the effect of shielding human perception from

the need to include externalities. It is less evident to provide a liability status (moral rights and deeds) to machines (robots, AI, etc.) than to humans, because this entails an enlarged ecosystem (typically, the machine designers, developers, suppliers, owners and users; the software code itself embedded within them; and all add-ons along the normal or exceptional usage profile – how can we distribute responsibility?)

Exercising the bundle of DDs on the concept of economic growth is equivalent to making its inherent underlying assumptions plain and conscious. They should be expressed with words, so as to work on these later on with a view to open up new avenues, which perhaps may even redefine it.

3.6. Categorizing four general fixations found in the economic world

As soon as we make a move to think out of the box, some cognitive hindrances pop up unexpectedly. These are fixation effects, "*a blind, sometimes counterproductive, adherence to a limited set of ideas in the design process*" ([JAN 91], cited by [AGO 14]).

These are die-hard tacit mental compulsions that tend to overwhelm our conscious reasoning from the background to conform it to an already agreed scheme. Not necessarily *idées fixes* but rather *déjà vu* modes of thinking (precedents) that hang up a free thinking, without having us noticing their presence. And they stir a collective resonance that tends to operate as plain common sense. Fixations also induce harmful consequences in professional settings.

First, they lead people to *decide* (i.e. a closing act) instead of design in open ways. Traditional growth indicators embody fixations and provide the ready-made instrument to determine the ways it should be and to settle matters. The first defixation rule is:

DF1: replace problem-solving with a problématique examination.

The Club of Rome has notably led the way since the seventies by introducing and exposing the "world problématique" in its 1972 report. What is a "problématique"? If we recollect Albert Einstein saying: "We cannot solve

our problems with the same thinking we used when we created them" we may gain a sound clue: that it is a view on the problem-as-it-is-defined. This has variants: problems cannot be solved by the level of awareness that created them. To resolve them, re-open the expression of the problem. Quite similarly, Churchman ([CHU 71]) customarily used the term "enormous problems". Along with his co-authors (among whom J. N. Warfield), Alexander Christakis ([CHR 05]) offers a brilliant insight: "the description of the problem clusters [is] observer-dependent". Hence, the way to "true" problem-resolution requires a step back, a meta level, perhaps even the definition of a meta-problem. This conceptual step is a cardinal K —> C disjunction in the terms of C-K (Concepts-Knowledge) theory used through this book (see Appendix 2) which can found the conceptual design of new growth concepts when applied to knowledge clusters in economy. Said differently, you cannot resolve if you remain in the same Knowledge space: resolving poverty, unemployment, pollution, malnutrition… cannot work by being confined to these notions; you need full access to the entire ecosystems around these notions. A problematique is the acknowledgment of the relevant conceptual vacuum around a problem. We furthermore found that the relatively very high level of systemic complexity of post-modern societal problems nearly always requires that sort of conceptual disentangling or de-siloing at first, hence the need to assert one or more problematiques at first (root concepts or C0 concepts). Which in turn require a specific and powerful enough design methodology to ensure their "processing" (i.e. resolving the problem(s) therein).

Second, fixations make us focus our attention more on objects and less on situations. In other words, we glare at items or something of interest as if detached from its environment and tend to forget the scene surrounding it. We are just losing the systemic understanding, embarking on reductionist approaches which lose the underlying meaning! For instance, how loudly and severely should a natural planetary environment speak to post-modern man's ears to finally have him condescend to hear its messages – be they on pollution, climate change, or other nuisances hampering living and the economy? The second defixation rule says:

DF2: issues are systemic by nature, therefore practice systems and complexity sciences from the start.

That isn't all. Third, fixations tend to have us stick to existing methods and techniques and not embark into radical solutions. We perform

improvements, we want to optimize (e.g. a yield by a small tenth of percentage), often at the expense of raising costs non-proportionally and reaching decisively unreachable asymptotes. A corresponding definition is less obvious given that it requires a substantial and convincing mind shift: to think in generic terms. This is usually arduous, and our long field experience with firms and administration testifies to the mental effort that is required both from the consultants and the coaches and from the clients' participants to grasp where the difference actually stands and the value of it. The easy way that is often practiced is to extend applicability, that is to think in more general terms. But this dilutes the thinking instead of locating a core element that underpins all. Hence, the third defixation rule:

DF3: work out and enhance genericity, not generality necessarily.

This rule induces to find global properties that can be used across the spectrum. It often requires associating economic players together, for instance though consortia, in order to obtain a proper reasoning amplitude. The semiconductor field uses several association schemes to think of the future, playing an instance of a coopetition (first collaboration then competition) model among the working parties.

And then the fourth way of fixations. A bit subtle but very common, it says that it is better to seek to improve the conditions than the things themselves. If you want to lower unemployment, look at the surrounding conditions (the state of things) that have led to unemployment (evidently, this may usually require a fully systemic approach) as a property of the system at hand. Instead of fighting it in the face. The latter option may obtain results in the very short term, but are they sustainable? Today, under the pressure of standard indicators, managerial options in the industry and the economy at large tend to privilege the short term, even the very short term. Managers are forced to want same day results, often sacrificing a better outcome that would only come later. Yet, management in the 21st Century plays with towering complexity levels, soaring determinants that weren't forecasted, and so on. The proper type of management for tackling such a socio-economic habitat is no longer to manage by fixed, *a priori* objectives, but instead to set the (proper) conditions for having people in charge to

design the best paths to attain (dynamic) objectives. Hence, the fourth defixation rule:

DF4: whenever situational factors count, and a less short-term solution is sought, improve them as a way to better a system globally, instead of pursuing the improvement of things locally.

This one incites to classify the desired depth of the target constituent to be improved beforehand. A great power can be released to regenerate growth by playing these rules in combination. These fixation varieties can mesh together. Let's illustrate this with an overworked example. Henry Ford's adage "*If I had asked people what they wanted, they would have said faster horses*", even if it possibly was never said[3], makes the point. Ford's genius actually was to understand the need for a better moving assembly line – a totally shifted problématique, having nothing to do directly with the speed of transportation. While the limitations of horse trailing were well-known, he cut prices instead! Yet, the story goes on, and what is a breakthrough at time t may be a sluggish improvement or a laggard at time $t + \Delta t$ – which can be the following day or the following decade. It so happens that Henry Ford was later outperformed by competitors, caught at his own cost optimization quest, who evolved the notion of a car while he had fixed it instead. De Rougemont [DER 77, pp. 167 ssq.] gave a deeper analysis of the underlying mechanisms… "*a Pyrrhus victory*" ruining the future.

Let's name a few fixations limiting the economy:

– on *ownership*: using an object (a product or service or whatever) does not logically imply owning it. Ownership and usage are two distinct notions; yet, we are used to wanting to own things. Even things we don't use. I may have a whole collection of coats in my wardrobe, but I'm always using the same two year after year. My car remains parked and locked for at least 20 hours every day of the year minus a few, which costs me rent; yet, I only use it on an average of two hours a day, while its market value has sharply depreciated since I bought it – what a poor investment I made. Or I tend to accumulate artwork in a safe as a valuable treasure chest in case of economic collapse, etc. To own is to experience a sense of power; to own many things demonstrates a certain personal economic strength.

3 https://hbr.org/2011/08/henry-ford-never-said-the-fast

– On *capital*: further to the above examples, capital is immobilized valuables. In the case of money, it's sleeping: I don't exercise the independence it could provide me by employing it in markets.

– On *scalability*: the two extremes of the scale being the individual and the global monopoly, we have two types of fixations: the isolated individual having no link to economy and the monopoly regulating economy.

– On *control and management*: the regulating bodies should be distinct from the management organizations.

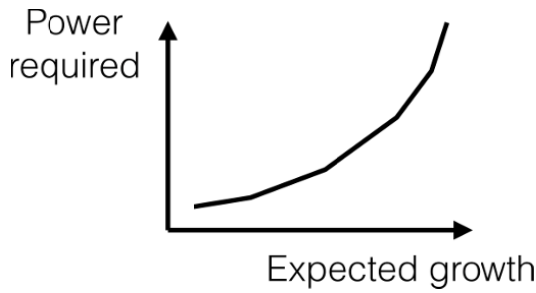


Figure 3.2. *Demand for growth typically calls for unsustainable power requirements. Hence, prices skyrocket while energy transformation becomes harder to sustain and maintenance becomes a hurdle*

Defixing is the next step to open up avenues for new growth. We do this by expressing a compelling root concept (we name it a C0 blueprint or *concept zero*) which may later prove true or false, yet with adjunct desirable properties. Let's try:

C0 – *A balanced economy in which every person gets a return.*

We express the root concept without specifying a type or quantity for the return. First because this is meaningless: not everybody would favor the same type (financial, benefits, support, etc.) or be attracted by the same things (objects, jobs, recognition, etc.). However, the decisive direction declared by the blueprint is here to detach from the non-distribution, which, as a result, would trigger a sense of power. Figure 3.2 shows the unbalanced expectation that is customarily placed on growth, it lacks lateral thinking.

As expressed, this blueprint holds the promise of, for example, distribution first everywhere, a fair trade, fair industry, fair craft, all of which in turn may produce an ever more fair distribution. The ensuing exploration systematically expands the emerging possibilities to the point of validating or invalidating their possibilities in our economic world. This will be developed further through many examples in this book, and the theory behind will be exposed in an appendix.

3.7. On the remarkable fixation on competition

Competition is a much studied subject topic and a central argument at business schools. Again, some fixations are inherent to the term that do not draw much attention. To begin defining it, we consider the term of competition in association with the term cooperation. How is it possible to take into account two such requirements simultaneously? Are they constraining terms or just raw principles for building something new? Do criteria and indexes exist that can take into account both competition and cooperation simultaneously?

By centering our focus on the dynamics and the evolution over time, it then becomes possible to develop the two terms in a dimension that defines the static definition of "competition" and of "cooperation". The dimension of these two terms becomes an energy dimension instead and can lead to balancing organizational aggregations. (We recall the well-known Prisoner's dilemma – altogether non-zero-sum game – in which cooperation modifies the gain of each of the two prisoners.)

Two immediate root concepts can emerge:

C1 – collaboration followed by competition: *coopetition* and

C2 – competition followed by collaboration: *comperation*.

The applicability field is widened: C1 and C2, plunged in a context of innovation design lead to and even extend the basic principles of Open Innovation. The management of innovation will be different than that which is common academic theory. In cooperation, the value of each stakeholder takes a larger place, which in turn alleviates the disharmonies arising from

a lack of recognition of the position of each stakeholder. Not the end of competition still, as the essential point is to get to a widened, interaction vision from strict routine work adhering to static views.

In this simple example, we see the critical importance of escaping binary visions and entering into a dynamic interaction of opposite notions, here competition and cooperation. This widens the scope of doing economic acts, of possibilities, of growth. While each stakeholder (a firm, a nation, an institution, etc.) pays attention to its own interest, it also plays a role in harmonizing the whole; an extended role that also accrues to serving its interests. With proper shared models in place, this can be accepted by all the parties as a way to widen the scope of business, of influence, of relations, of possibilities.

More generally, this evolution becomes a new requirement born from the ever high complexity of societies. When the degree of complexity arising from technological evolution and the dominance of networks is so high as to make mathematical and hierarchical models insufficient to account for the dynamics of society and its living beings, it is lateral connections that develop in all the directions, supported by behavior-inducing social networks of many types. And this leads to widening the possibilities of interactions, which is rooting new growth.

What would you teach to educate a young generation then? Competition in the age of Schumpeter? Or thinking methods that are adapted to the new challenges? That is complex systems and their dynamics and evolution?

Unfortunately, our thinking (companies, nations and individuals) is still directed by a linear mindset that tells us “consume to make growth happen”. But we now happen to realize that an infinite increase in consumption has physical limits at planetary level. By neglecting the feedback loops (popping up from the disharmonies created, the global uncertainties), the economic infrastructure is now clearly found at odds with nonlinearity and will run into the wall of physical limits by way of increasing production costs and global risks.

3.8. Implementing the defixation process

The overall method we implement in this book calls for the following terms, which are gradually introduced throughout the chapters and refer to the C-K theory explained in Appendix 1:

– Background knowledge: the state of the art in the domains considered.

– Fixations: the sedimented habits described above.

– Dominant designs: the operation models used, based on past hypotheses.

– Breaking axes: the directions for designing operational ruptures.

– Blueprint concepts: a set of projected out-of-the-box expressions.

– Expansions: the conceptual explorations leading to new ideas.

– Project definitions: the selection, definition and documentation of these new ideas and their incorporation into time-staged actions.

This book aims to provide the ground work for tackling this whole series of notions and activities.

4

The Historical Contribution of System Dynamics

> "The world has also learned that economic growth, by itself, cannot close the gap between rich and poor."
>
> The Dalai Lama

4.1. The pioneering work at MIT

As recollected by E. Barbieri Masini [BAR 06], the underlying concept of a working Club of Rome since the 1960s was the "*world problématique*". During those early decades, its founders were compelled by the global nature of the changes they observed and their interrelations. That was above all a time of analysis of the facts underlying the changes, and of the concrete way to redress a compromised global situation. Yet, the aim of the analysis was to obtain a *synthetic vision* that could be translated into an *action plan*. And the analysis was performed by using a new discipline called system dynamics.

System dynamics – the simulation method used for the "Limits to Growth" studies – is a modeling approach based on the principles of feedback and secondary effects. It attempts at representing the dynamics of a situation by sketching causal loops, and thus enables raising awareness about the role of exogenous and indigenous factors that are relevant to the problem studied. A computer model then incorporates them as equations, and running

Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter, First Edition. Patrick Corsi.

it gives insights into the future evolution of the given problem. Cyclical phenomena can thus be taken into account that are underpinning the problem at hand. Actually, that really nothing is static and everything is dynamic was a property emphasized by then as an intrinsic property of systems.

This approach hence came as a way to escape the former static way of looking at things. It brought up, thanks to causal links, a capacity "to dive into the future evolution" of a given system. It made the findings sharable, and therefore consensual decisions could be made accordingly. As a genuinely *systemic* approach, it constituted a decisive path towards an early capacity to tackle complex systems, moreover at the global level for the first time ever. Given the onset of the complexification of society at large, it was surely a right, if not *the right* approach. Note that here, the term "complex" is to be taken in the sense of complex sciences.

Jay W. Forrester was himself the founder of system dynamics. A professor at the Sloan School of Management at Massachusetts Institute of Technology, a systems scientist, he was leading a team at MIT [FOR 95]. He recently wrote down how he came up with this discipline in a highly informative paper published by McKinsey & Company [FOR 95]. Being both a practical investigator and a theoretician, he was mostly interested in "*tackling issues that made the difference between corporate success and failure*". He for instance asked himself why high-tech companies can grow to a certain size and then stagnate or fail. Modeling such dynamics was the central thing for him to picture.

Actually, we ought to go back to the early 1950s when Forrester was developing a technique he called "industrial dynamics" (and which was to later become "system dynamics"). Thanks to it, he was instrumental in showing that *time* had an impact on the performance of an organization. That the evolution of production systems stifled the static view, they weren't merely schedulable. This was the onset of nonlinear studies bearing a dynamic and adaptive behavior. For Forrester, any system is dynamic. And this means that it is chiefly time that dynamically influences such notions as client demand, the fluidity of a supply chain, the delivery delays, as well as stock ruptures, process convergence, divergence or malfunctions (backlog, saturation).

Massotte and Corsi [MAS 17] explain that,

> "*No one approach intended to optimize or improve a process is fully satisfactory. It either costs time to model the problem or to run it. This is why different refined approaches have been proposed often based on System Dynamics.*"

Other highly dynamic behaviors exist in complex production systems, like *chaotic*, in the case of a non-predictable system which may contain a fractal structure and reveal emergence properties. The way to act isn't direct on the production system but in setting proper conditions for it to behave properly (and hence the management shifts to a different type!). Many scholars have studied *cellular automata* and *self-organization* and applied them to cellular manufacturing, given that a manufacturing system consists of several interconnected production units [MAS 17]. But using similar approaches to tackle the "world problématique" seems out of reach for several reasons:

1) too many autonomous agents (i.e. resources) communicate with their neighbors according to a local production strategy to organize the best coordination;

2) scaling up the optimal level of autonomy, the coupling level between agents and the production strategies in and between agents remains too difficult or impossible;

3) therefore, simplifying the product flows, reorganizing the production in case of a disturbance or unexpected events occur.

These arguments are extracted from and discussed in [MAS 17].

4.2. The historical quest for cracking the "world problématique"

An adequate tooling to model the world situation in the 1970s and its likely evolution resorted to system dynamics. There were several reasons for such a choice: e.g. countries' data were beginning to be available for analysis; computer simulation and programming were booming; and systems were happily studied *per se*. Forrester was among the leading pioneers of the digital age, and his unexpected irruption in tackling the world problématique of the Club of Rome after his urban dynamics modeling activity provoked a

striking synthetic effect: to model the complex interactions of the world economy, population and ecology.

System dynamics was suited to system-based approaches. System dynamics was suited to system-based approaches, systemic thinking, and system science. However, evolving established and known models in the Unknown becomes irrelevant. A new algebra for tackling "problématiques" is required. Since 1972, studies were based on system dynamics theory and computer modeling (Forrester's inclination). It is dominated by cause–effect relationships and mechanisms (vocabulary: growth, limits, delays), but it does not accommodate ruptures.

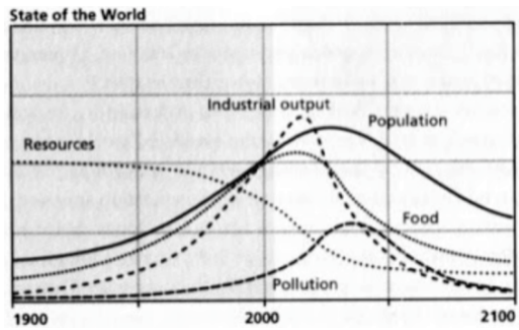


Figure 4.1. *The "base case" scenario late 2004 study from the Club of Rome (cited by Ugo Bardi [BAR 11], where the Seneca effect (forward leaning curves) was already observable*

The major lessons from Forrester are probably these: the necessity of systemic approaches and the requirement to trace any development. Systemic analysis works by confronting models with input parameters, and the notion of feedback coming from cybernetics is paramount therein. Strikingly, none of these lessons appear in accounting of firms and organizations, countries included. Many economic notions (balance check, GDP, etc.) are extremely reductive and do not reflect a living reality. Accounting resembles more an art of the dead, while systemic Forrester's analysis was a science of living things. The problem is that we measure

respectively to account figures, and this is challenged nowhere. It should be, from now on, if we want to create an evolving society. For instance, what is immaterial (such as information and knowledge) has no intrinsic value; in other terms, it isn't an asset.

4.3. The historical outlet with the Club of Rome

The timely conjunction of a deep reflection within the then small group of the Club of Rome founders with Prof. Forrester around the early 1970s revealed the high relevance of Forrester's approach and led to a historical spark for a new understanding of the evolution of mankind at the socio-economic level.

The Club of Rome's authoritative bestseller "Limits to Growth" thus came out to the fore, signed by Forrester and his student Meadows [MEA 72], showing for the first time the inextricable entanglement of five dominant world-level factors:

1. Population
2. Environmental Degradation
3. Depletion of Non-renewable Resources
4. Industrialization
5. Food

It was then that MIT's system dynamics approach was tasked with the simulation of their interrelations as a contemporary proxy for tackling complexity. Not many studies have threaded the complexity line of thought at such a global level since then. Recently, at the level of global policies, a pamphlet on complexity was distributed to the participants of the World Economic Forum [WOR 13].

4.4. On complex systems and the legacy relevance of system dynamics

The science of complex system was in good part invented by John von Neumann and Norbert Wiener. John von Neumann said, "*the great progress in every science came when ... methods were developed which could be extended further and further*..." which enabled analyzing long-term causes

and consequences of growth in the world population and material economy, addressing such questions as society's future sustainability or collapse.

To give a few examples of our level of complexity: the services we use are founded on an intensive information processing. We are used to dealing with synchronous mechanisms: the events and their impacts and consequences, the transactions on trade markets (smart contracts with a blockchain, stick exchange, etc.). Time is hashed into the nanosecond, far tinier an interval for humans who are displaced right away and are left to either provide some offline guidance or perhaps to push a red button[1]. Our social networks have made us inter-agents caught in real-time nexus of immense diameter. We operate several pseudo-identities on networks, as if our self was living in superimposed states.

When in complexity, it is the (dynamic) links and relations that supersede the mere notional domains – for instance, work *and* employment, money *and* finance, growth *and* GDP. It is necessary to first deconstruct these old single notions (which should professionally be done with the help of domain experts), then to put them in relation, with a view to project fresh blueprints.

System dynamics was surely a right approach insofar as the then knowledge of the dynamic global economy could be encapsulated and projected into developing curves: a set of brilliant scenarios for the future years. Under the burning pressure to mitigate the incoming systemic impairments sooner or later, the Club of Rome created the notion of *limits* as a boundary condition to growth. Unfortunately, e.g. the French translation said "*stop the growth*", an admonition that met much misunderstanding and wasn't necessarily meant in the original works. Limiting something semantically compels to include e.g. the guiding or the balancing of it, not its revocation. And not necessarily its reduction! Could it actually open new directions and source new measures for "righter growth"?

4.5. On the psychology of "not wanting to know"

Unfortunately, despite a huge success (or perhaps because of it?), the general public didn't follow, neither at that time nor in the following years, instead choosing to bury the issues further or organizing workshops to curb the curse that was announced. Instead, does a Cassandra-

1 Recently, such a mechanism was even patented by Google (late 2016).

like pattern seem to have followed? By not wanting to immediately understand a "prophecy" given some hidden fear behind saying there is much to lose in the future? But it wasn't a mere prophecy, it was a rigorous model based on system dynamics and fed with real data!

Should the Club of Rome have invested in marketing to promote its report as a tool for curbing the future? Remember, the early 1970s years were exactly those exacerbating the first "future shock", from oil price actually, and nobody in the street was mentally prepared or intellectually equipped to logically sense and mentally anticipate the best long-term paths. The report came with total evidence, at the exact event moment for humanity – a rare feat in futures studies – but at odds with the maturity level of the latter! What an anti-synchronicity!

Such behavioral patterns aren't rare, and there exists research to explain it. Facing the future should be a science, but resembles black magic. Recent research from two European researchers [GIG 17] published by the American Psychological Association[2] clears any doubt about a typical humanity blueprint:

> "*Wanting to know appears to be the natural condition of humankind, and in no need of justification. […] Not wanting to know appears counterintuitive and may raise eyebrows, but deliberate ignorance […] doesn't just exist; it is a widespread state of mind.*"

Collectively, we could probably do better. Even if the authors [GIG 17] state "*The theory also implies the time-to-event hypothesis, which states that for the regret-prone, deliberate ignorance is more likely the nearer the event approaches*", and "*deliberate ignorance exists, is related to risk aversion, and can be explained as avoiding anticipatory regret*", there must be a way out from an individual and collective state of mind that isn't much aligned with the pressing demands of our critical times. Or are we happy in being a collective loser:

2 See the APA site: "No Spoilers! Most People Don't Want to Know Their Future", http://www.apa.org/news/press/releases/2017/02/know-future.aspx, February 22, 2017.

> "*By declining the powers that made Cassandra famous, one can forego the suffering that knowing the future may cause, avoid regret, and also maintain the enjoyment of suspense that pleasurable events provide*" [GIG 17].

The fact is that rescuing present-day situations of socio-economic imbalance now requires fresh approaches, including perhaps some meshing of traditional disciplines. Before attempting at opening new ways, let's recapitulate the principles around which the "Limits to Growth" report, published as the first report to the Club of Rome in 1972, revolved. The report raised an awareness about humankind evolution around three key principles [PEC 69]:

1) "Humanity and the global environment are both parts of the same integrated macrosystem."

2) "Many of the components of this macrosystem are at risk of breaking down, or even of totally being destroyed."

3) "Developing such a global plan and implementing it are a collective obligation of all groups that have the capacity to do so."

In essence, the report was targeting the non-ecological kind of growth that was raised to the status of a universal sacred cow. But now, the whole system appears to be falling apart. The walls of the consequences are raised inexorably before and around us all. Rich or poor, the observable signals speak the same language for both.

4.6. Some prevalent differences and similarities with the seventies

What has changed since the 1970s and what are some of the main differences with the world problématique vision of then? In a nutshell, a remarkable time span that passed since the Industrial Revolution crossed to the Age of Information and dived into networked societies, soon letting go to swarmed societies. Society has become more global, the combination of constraints brings a new form of higher order complexity, we are beyond the limits (presence of overshoot situation), we are past the global ecological constraints, past sustainability capacity – they are binding. Growth is only one parameter – the problématique is now systemically wider.

The first difference is that the world faces a *nexus* of problématiques: none can be singled out anymore, they are all linked and entangled. Model terms aren't exclusive to one another; binary situations (e.g. "no work, no growth", "poverty or growth?") leave room to both being right (e.g. poverty is both cause and consequence, competition and overshoot are both causally linked and separate issues). Micro- and macro-levels are intensely linked in systemic dynamics (e.g. crowdsourcing grabbing global effects), while standard science only recognized a mince role for a meso-level middle ground. A consequence is the fall of ruling top-down models and the need for hybrid ones. Or once-for-all decision-making leaves room to continuous negotiation-making.

Secondly, today, humans seem to be fighting for the survival of their natural environment: this attitude proves a nonsensical paradox, whereby it is Nature that instead prevailed humanities since the origin of life on planet Earth! We wouldn't wish to orient this discussion anthropomorphically (is Man in a God-like mission to restore a rapport to himself re-source Nature?), only rather desire to center it on a possible humanhood evolution. That a problématique should instead be internalized and be expressed as human-centered, not on external goals.

By internalization, we mean to permanently observe our operative level of consciousness. For instance, we tend to entertain and abide with dualistic reasoning (e.g. the many Manichean rivalries between pairs of opposites: East and West, North and South, the oppositions between arms race and peace efforts, etc., as for instance studied by Johan Galting [GAL 17]). A prevalent degree of consciousness in humanity seems to reside in perduring dualistic confrontations. What about entering ternary models whereby the injection of a third point provokes a movement (dynamics) that resolves the tension and regenerates the two polar opposites? This is a technique that was frequently used in diplomacy (unlocking intractable issues), yet bears generic potential.

Conversely, what are some of the similarities of the approach compared with that of the 1970s? First, a new resolving approach should, as always, be capable to depart from the dominant thinking of the times – this time, we mean our *present* times. Indeed, as in the 1970s, the huge volume of data generated and sedimented everywhere around the planet in the data centers amounts to a massive flooding of human analysis capacities. Surely, the mining of deep data leads to interesting information, yet remains hard to translate into fresh knowledge and wisdom ([BAR 06]). A similarly rampant

ignorance prevails today, perhaps at another level of complication, and no clear guiding principle seems to exist for ensuring continuity (read sustainability) in the fields of human endeavor. In a sense, the trees continue to hide the forest.…

Secondly, the technological developments have continued towards astonishing levels and paces (we simply name nanotechnologies, biocomputing, artificial intelligence, virtual realities, machine learning, and the realities of cloud computing). This curse is, as always, unstoppable and, for the tenants of the singularity philosophy, now represents *the* dominant factor in human evolution, on the fast way to transcending man [SIN 16].

Another possible difference is that the rapport between man and technology is certainly much more debated today and leads to a wide range of scenarios from self-discipline in giving status (read responsibility) to artifacts (read status quo from robotics) to transhumanism. Also, younger generations, who tend to think and act differently, may have a different say sooner or later.

But in the meantime, what should be said and done? It has become capital to reinstall the striking Club of Rome vision while reinterpreting it by regenerating its original touch and furthering down anticipatory capacity.

The Club of Rome was right in detecting an alarming situation. It was a historical breakthrough, the most positive step for humanity. However, evidently, it is always difficult to support a Cassandre observation because it is generally perceived as a destruction of market and social value. That destruction is obfuscating the perception of the value.

4.7. Getting away from system dynamics from now?

This brief narration of the inception of system dynamics into world-level evolution comes for a reason: to go back to the motives for its choice and the surrounding hypotheses of the time. Too often, we continue to take methods and techniques for granted too long while the factors rooting their applicability have either vanished or evolved. But since we lose track of the surrounding changes, we forget to revisit the applicability of the methods we use, not that they have become inefficient (they could still provide the same calculations to you), but that they simply need to either evolve, change or be

substituted with time in order to take into account new factors that alter the previous hypotheses and premises of the time.

Today, we do have such impending factors, and they may be more subtle than those before. For one, the sheer level of complexity has grown tremendously in society and in business where, in a nutshell, "everything gets connected to everything", a living or not a living thing. The direct consequence is the sheer multiplication of feedback loops, of many orders, hence the tantalizing effort to take them properly into account, modeling wise, computation and time wise.

Secondly, as eloquently whistleblown by the 1973 report, the role of environmental degradation at large (including pollution, resource depletion and waste) becomes today so intricate and dominant that these are no longer factors. Their status has shifted to the one of overall constraint. Like if we were sitting on the descending side of a curve instead of ascending. Like if we couldn't buy time any longer. It is not the role of this book to open the debate of whether there is or there is not such (detrimental, resource abundance, climatic, etc.) change overall, yet we would opt for not giving credit to negating them. Therefore, it is no longer a condition monitoring situation, which could be mitigated or perhaps controlled by means of algorithmic, artificial intelligence capacities, or other adaptive solutions. We posit we're no longer in a problem-solving situation! We're in demand of an outright radical shift, be it a technology breakthrough, or a different way of living, or a new consciousness, or else. And this somehow needs to be designed. After all, we follow the extended language used since the inception of the Club of Rome by using the term "problématique" and "resolutique".

Differentiating the design-based approach from problem-solving is crucial, even if not evident. Finding a solution to a problem presupposes that the problem is (1) known, (2) well-circumscribed and (3) well-defined in some accessible language. The path to the solution obeys the rules of some discipline, a theory, a demonstration, a computation, etc. It can be an optimization, or a planning, or scheduling task, or it can use the well-known reasoning logic mechanisms of inference. It's become a world of the "knowns" dealing with the surrounding uncertainties, where probabilities and statistics play the two modeling and predictive roles.

But is this the situation we are really facing in the 2010s? We believe we have entered in a world of unknowns. Where the right models simply are, at

best, unknown and possibly not reachable or even existing. Where things are neither true nor false, but bear an undecidable status. That is, when they fall in a genuinely perplexing category, what model, what theory can we call to apply?

To be honest, the theory exists fortunately, but its formal construct is a poor practical help in mundane situations. It is mathematician and logician Kurt Gödel who demonstrated by means of formal logic the difficult so-called two theorems of indetermination [GÖD 17].

What is however of the highest interest is the design innovation theory developed after these ideas named concept–knowledge (C-K) theory by the Centre de Gestion Scientifique of the Ecole des Mines in Paris. After seminal work through the nineties, the group led by Prof. Armand Hatchuel was able to formalize the design activity relative to unknown "objects" [HAT 03]. And they even proved the equivalence with a previous mathematical theory called Forcing by 1966 Field Medal laureate Paul Cohen in 1963, which gives us the strength to tackle problematics dealing with unknown objects.

In short, when dealing with conceptual unknowns, the situation cannot be satisfactorily addressed by pasting a pre-elaborated scheme (theory or technique). C-K theory is conceived for that purpose, and this gives a fundamental reason for using it when discussing the "fabric of growth".

4.8. The position taken in this book

How to restore the original ideas behind the historical Club of Rome report? How to decouple from the "psychology of not wanting to know"? We believe that adding the proper justifications backing it is doomed: this may re-awaken fears.

This is the reason why we took a totally different approach in this book, i.e.:

The New Growth Problematics
A design-based growth capacity, enabling the creation of an infinity of growth sources, with wished properties, constructively, that is traceable, and can be coupled with planners' and executives' strategies within organizations.

What matters is to create original decision-making systems that are able to behave differently. For instance, not choosing between de-growth or uncontrolled growth, but a different growth. In other words, to escape from a dilemma (a duality) and imagine a third way. This should be done through an anticipating capacity plus a design ability for new alternatives or states. Hence the design innovation way we foster in this book.

PART 2

A Methodology for Tackling Growth Problematics

5

In Search for New Approaches Fit-For-Purpose

"If we're growing, we're always going to be out of our comfort zone."

John C. MAXWELL

5.1. A GDP comfort zone

Based on the discussions provided in the previous chapter, we are faced with a recurring degree of "non-capacity" for dealing with the "world problématique". Or at least, in the ways we've been trained to implement, i.e. computational models with a *quantitative* modeling dimension. As said, we won't follow suit in this quantitative direction, due to the intrinsic complexity that has appeared before us all in terms of degree and scale.

Yet, are we to abandon the "résolutique game" by the same token? We won't indulge in a common thought form that would induce that everything is unsolvable and that we aren't in a position or simply able to be active and productive to modify the prevalent conditions. This pessimistic position is too heavy to bear! Instead, let's free ourselves from it and allow each to believe and to sense that he/she has the adequate activating potential stemming from positive thinking.

Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter, First Edition. Patrick Corsi.

If we fight with numbers – a qualitative approach – we lock ourselves in a duality of thoughts, but by using information, we begin to offer a strength that may rebalance a previous situation, as well as an attitude that unleashes what's positive in each of us. This posture underpins the models that we will be developing throughout this book. To begin, let us recall a standard definition of the all-dominant economic performance "Gross Domestic Duty", alias Gross Domestic Product or GDP. From Wikipedia:

> "The OECD defines GDP as 'an aggregate measure of production equal to the sum of the gross values added of all resident and institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs).'[2] An IMF publication states that 'GDP measures the monetary value of final goods and services – that is, those that are bought by the final user – produced in a country in a given period of time (say a quarter or a year).'
>
> Total GDP can also be broken down into the contribution of each industry or sector of the economy.[4] The ratio of GDP to the total population of the region is the per capita GDP and the same is called Mean Standard of Living".

To be honest, this all-enduring standard definition has been under attack quite a few times by eminent scholarly authors. Marylin Waring [WAR 88] was eloquent in denouncing the unpaid work by women gone into oblivion. Wikipedia says that her work *"persuaded the United Nations to redefine gross domestic product, inspired new accounting methods in dozens of countries, and became the founding document of the discipline of feminist economics"* [LAN 13].

The notion of GDP has also consistently neglected the natural environment. Or more generally, should we perhaps say. For the caring dimension, a loving attitude, a guardianship posture and all left over in the background of any accounting sheet were not brought to awareness in recent times at least, and this brings unwanted background tensions in society.

Present balance sheets are not of a balanced society: they are simply not inclusive of all the forces behind production and performance.

It is highly illuminating to listen to Belgian Bernard Lietaer [LIE 02], a former high bank executive and the recognized design expert behind the forging of the Euro currency. His elevated and fascinating 28,000 years historical analysis of the intimate relationships between money and monetary systems through the ages, femininity and the female Goddesses, and our deep-rooted societal archetypes, show but one dominant factor that we will express here in a rather blunt and perhaps categorical way: a dominant masculine grip on an altogether all-encompassing and altogether nourishing wealth of opportunities breathed by Nature and humans. A work related to famous Swiss psychiatrist and psychoanalyst Carl Jung's [JUN 15], who excavated humanity's archetypes and embodied them in what he called the collective unconscious.

What happened then to our modern and post-modern times crippled with financial crises and soaring environmental issues[1]? Are we capable of restoring balance in society's systems? Notably, but a bit cautiously since years, Silicon Valley uses the following economic drivers in addition to GDP: jobs, M&A IPOs, patent registrations, venture capital and angels investments. EUROSTAT, a Directorate-General of the European Commission located in Luxembourg and the official statistical information to the institutions of the European Union [EUR 17] has a number of innovative creativity economic indicators. The Joint Research Center [JRC 17] – the European Union's Science hub – is working on innovative economic and GDP macro indicators. In [BRI 03], Brian *et al*. group and describe a number of alternative indicators for economic welfare. They base their analysis on some interesting principles which are sometimes still in use, e.g.: using consumption as the starting point of calculations, adding services, subtracting a number of negative costs and natural resources depletion, etc. They end up recomputing a startling "progress indicator" as depicted in Figure 5.1, thus dramatically revising an overall well-being computation.

1 Including the economic, financial, currency and banking crises over time (see, for example, [MAK 12]). Human consumption overshooting Mother Earth regenerating capacity as symbolized by Earth Overshoot concept (http://www.overshootday.org).

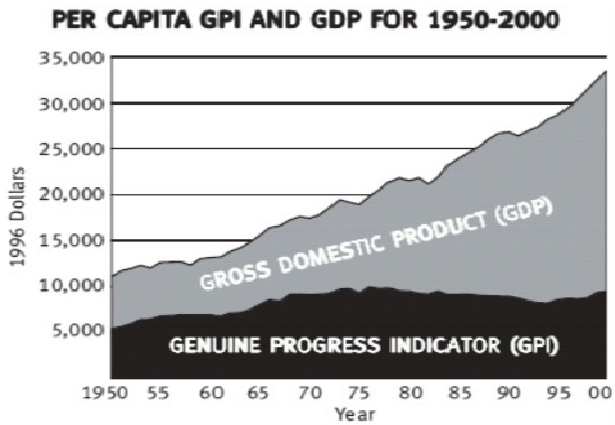


Figure 5.1. *Redressing a GDP computation at the light of alternative indicators (from [BRI 03])*

During the 1970s and 1980s, the Productivity Paradox[2] alerted on the discrepant US productivity loss in the face of a soaring computer power and IT investments increased (it was popularized under the Solov computer paradox "*You can see the computer age everywhere but in the productivity statistics*"). We recall that Keyneysian economist Robert Solov was awarded the 1987 Nobel Prize for his growth theory [SOL 88] where technical progress is the main factor pulling economy towards ever new growth stages (otherwise would become stagnant). How the model essentially links growth with savings and population increase is thus rooted in dominant designs and leads to a model of exogenous growth, even if well connected to the social factor.

5.2. In search for growth

Based on the high level of complexity of society, we instead believe it is *endogenous* growth (including *inner* growth) that is the big next step forward. By endogenous, we mean restoring the dynamics of individuals and their means. Shouldn't we dare to say today *you can see a GDP measure everywhere but in the everyday life of people?* Testimony is the vibrant economy and construction at all levels within villages and cities boasted by

2 https://en.wikipedia.org/wiki/Productivity_paradox.

medieval time people, contrary to perhaps a dominant perduring view of an archaic age. Lietaer [LIE 02] explains the medieval wealth and development may not have been by the invention of market or money, but surprisingly by the high level of taxing of money inducing working class people to (1) discourage money savings, (2) reduce money usage mostly to transactions and expenses and (3) encourage instead savings in the form of tangible goods, and by consequence especially sustainable ones. He stresses that the technical decoupling of:

– the exchange function (through money) from;

– the savings behavior.

enabled investments in the open, plus with a special caring for quality (of the land, the irrigation machines, the windmills). This decoupling provoked a polarized collaborative effort effect towards ever more improvements in the economy and society. Our quick summary for the present book is that a medieval policy measure fostered *distribution.* Obviously, in an indirect way. Unfortunately, today we tend to view distribution in the reductive sense: partitioning and sharing what exists already. It was then an "open distributive" mechanism based on ever-growing assets.

As the approach taken in this book is to deepen concepts, we but sense that humanity as a whole is still imbued with some fundamental thinking archaisms:

– the logic of rarity (and the elasticity of price, hence of value), which triggers greed and concentration of resources;

– the logic of zero sum games (the closing of interchanges through "offer against demand"), whereby what one gains the other must loose. Face-to-face competition tends to exacerbate this model;

– the distribution of resources as little more than a division of wealth and means.

Note that a *concentration* of the means tends to increase and control rarity. However, things do not need to remain so closed. If we are considering the "energy" behind the notions (reinserting the five foundational and intertwined codes discussed in the introduction to this book, among which the code of energy), it becomes possible to envisage a positive distribution of goods, to shift from a consciousness of rarity to a

consciousness of distributed, widely open abundance. It is always the way we think that closes mechanisms, as if they were physical.

Are we soon able to think the multiplication by way of apposite intention, which this uncovers open returns that were neither present nor anticipated? This change requires degrees of cooperation penetrating the existing layers of competition. Cooperation infuses a quality of energy that enables the creation of movements in economy and society. With movements, things evolve and consciousness as well.

Our school education instructed us to consider energy in the physical way only, but this is rather restrictive because energy is life, it enables the evolution of life itself, and makes everything a living thing, participating to the global evolution. We would be better off if we could model economy as energy correspondence. We produce energy through grouping, through what unites us, even conceptually, through what we want to build, and so severing from the mere material accounting dimension of things. All what we elaborate, express and explain participates to the energy correspondence.

One frequent option is to use (material) energies more efficiently. More kilometers per liter (consumption), more lumen per light bulb (more efficacy), more powerful technologies (productivity), leaner control (management), less volume per device (miniaturization), etc. Being more efficient[3] in what we already do. All these choices are valid but they bear a price – their cost – through the new longer-term dependencies they may create. And in the end, they just adapt the parameters of the economic game without changing the route. Is there a way to instead break free from the host of the dependencies created? This would require free thinking first, because what is at stakes is to change game, not just "energy efficiency" which keeps the same game ongoing.

Classic economic theory regards price as relatively elastic, but the famous idea of Markowitz's *efficient frontier* (the combination of assets with the best profitability at a given level of risk) is caught between the polar opposites of supply and demand:

Supply → Price → Demand

3 Note the distinction between *efficacy* (which depends on the quality of the system and customer satisfaction) and *efficiency* (which determines the performance and profitability/ productivity of the production system).

Here, the two polarities (supply: give; demand: take) delineate a transaction in terms of the possession of an asset compensated by a financial sum. Technically, this is an engineering approach (using, for example, methods of quadratic optimization) to resolve problems in the world of finance. Of course, this polar duality expresses a power of transaction but falls short of opening up a market potential opening.

In [MAS 17], we wrote: "*[Economist Joseph] Stiglitz shows that an efficient equilibrium does not exist at the level of information, we believe that the only way for realistic equilibrium is through dynamic equilibrium, hence the interest in a complex approach."* And concluded that time is up *"to renew economic theory through approaches that combine both microeconomics and macroeconomics, where regulation gives way to value spirals: these are the seeds of what we now call efficient innovation*".

The question now is how to, in this case, develop the customer relationship in a truly open and continuous interaction, in other words how to manage continuous innovation. The "Slow Food" movement is akin to a de-growth philosophy plus a consciousness raising in all we do as an actor being part of a bigger whole, a "belongness". But the de-growth notion seems insufficient in an age of mental dominance: our tendency is to call for models and proofs. Another approach is "going with the flow" [BAR 14], mimicking Nature which is dubbed to know what to do in every situation, as long as we stop injecting aggravating factors.

Let us wrap up and sketch what could core a new economy, **centering economics on:**

– consumption;

– profit (for a creditor);

- the profit gradient is the current economic rule;

- offer – demand is the main dualistic model;

- wealth concentration is the eventual outcome;

– (dynamic) equilibrium;

– movement;

– from distribution;

- from the start;

– man at the center: what you need and only that (Manitonquat's definition);

- what is more important, less important;

- urgency versus importance;

- quality better than quantity;

- proximity not remoteness (meaning-for-me);

- autonomy.

5.3. How to correctly model the situation problematics

Yaneer Bar-Yam from Boston-based complexity institute NECSI [BAR 97a] introduces two concepts for installing our post-modern world in transition from human beings behavior to human civilization:

– *complexity Profile:* the amount of information necessary to describe a system as a function of the level of detail provided;

– *scale of observation*: the level of detail visible to an observer of a system.

He states "*the history of civilization can be characterized through the progressive (though non-monotonic) appearance of collective behaviors of larger groups of human beings of greater complexity*". He asserts that the complexity of challenges that humans can collectively overcome goes on a par with the complexity of a system's behavior, in particular the social and economic contexts.

Humans get ever more "collectively animated": using social networks like fork-and-spoon is a testimony of the rising of complexity to a level unseen before. When globally observing, for instance, the quasi-Brownian movement of cellphones over mobile networks (i.e. human beings carrying them), we cannot resist seeing atoms instead, visible particles in motion in subatomic world. Which laws apply? Those of yesteryear mostly mechanical in nature? But then, we would still be describing human activities at the individual scale while humanity as a whole has already generated a more global effect. How do you compute the economy going on?

We have looked at a collection of approaches: games theory, dynamic pricing, the notions of utility, the coupling and decoupling of systems, innovation science, etc. Should we preferably take a thermodynamics analogy, we could say that the "humanity temperature" has raised due to the increase of a seemingly random motion of individuals. Humanity weathering up… but is the motion really random or is there some yet unsought order emerging as a collective behavioral result? No longer resulting by the will power of some independent group or organization, but collectively. What can exist beyond the known forms of legal social organization like corporations, associations, etc.? This would presumably signal a new form of human consciousness. Are we sensing a few new key-words here? These probably:

– *communication* between, *coordination* within and *cooperation* among the individual components (human beings and their groupings);

– this inducing a level of *correlation* between all these elements;

– plus a *coherency* at the global level that expresses a finality for the whole.

Although difficult to accept, a characteristic of complex systems is their unpredictability! A succession of facts and events that we cannot explain or anticipate. This is due to our inability to assimilate and handle a large number of interactions, our ignorance of the fundamental forces and laws governing the system being studied, and the uncertainties associated with the initial state, or an event, etc. We are therefore left to make a prediction through simulation (such as in the Club of Rome report cited above).

But this diversity, stemming for complexity, must be absolutely preserved; it is a source not of weakness, but of wealth, because it regenerates the elements of the system, and hence favors the solutions. Towards the top end of the scale, the environmental challenges place a call for a possibly novel collective complexity level of human civilization. This next level would be "cosmic", involving the positioning, with roles, for planet Earth as an entity in a yet bigger than today arrangement.

5.4. Leaving duality

Here, we stumble into the wall of our own representation ways. Let us consider the dominant model a civilization has used and its corresponding most abstract level:

– *Take or Leave* (i.e. eat or be eaten!): The primitive humans tasked themselves with survival actions like hunting. Their corresponding abstract model level is "the number 2" (me or it getting the supremacy). Does this ring a bell in the traditional accounting way:

- give & take, debit & credit, etc.;

- leading to mimicking others (competitive face-to-face posture) and me-too businesses replicating what already exists;

- brute force action–reaction scenarios. With the resulting fragmentation leading to fear.

– *Nurture/Capture and Divide:* The agrarian communities cultivated in order to feed themselves; wars captured another's wealth to strive. The abstract model level prevalent here is the physical "space": territories and their organization as nations, armies, commandos, etc. Fact is that the physical borders encapsulate meaning, the hierarchies are grown and control (all the way from diplomacy to coercion) is exercised as an influence to maintain ordered interactions that induce certain behaviors. Still it is duality.

– *Grow or be Subsidiarized:* The industrial civilization internalized wealth by being able to disseminate products through markets. It is the mechanism to maintain coherence that must be translated here. The dominant abstract notion here is "time" because all power became a consequence of proper timings in delivering artifacts-upon-needs. Organizational borders (e.g. multinational firms) encapsulate meaning.

Bar-Yam [BAR 97a] introduces the notion of lateral interactions to complement hierarchies that "enable control to bypass hierarchies" and illustrates them with the examples of military force and factory production that seek to maintain coherence at the global level. He insists on saying that this is *always* "*performed in response to specific external conditions*". And this remains true for nations and corporations alike, while these develop various scales because actuating complexity reaches a ceiling limit at any given level (this being due to the limits of coordination work). The control and coordination being distributed across networks allows the increase in complexity of the whole. Interestingly, the entropy (i.e. a measure the disorder) of the whole does not continue to increase as it would have been the case with, say, individuals or small groups. It resembles a filtering process (subsidiarity in policy-making is a form of filtering out issues depending on the take up level).

Bar-Yam says the complexity of an organism or organization must exceed the complexity of environmental demands in order to survive; otherwise, it fails (to be blunt, dies out, etc.). As time pressures to grow complexity levels on both sides, we have here the fundamental equation for the safe behavior of any system. Interestingly, it is competition that has offered and still offers the push towards the increase in complexity from the organization side. Because it is a contagious phenomenon, hence entails transitive pressures across the organism. From this observation follows the change philosophy prevailing as a dogma within socio-economic spheres.

We consider that the classic economic models do not enhance the interactions enough:

– "positive" interactions with consequential diverging processes (increases in prices);

– "negative" interactions with symmetrical consequences stabilizing the economic system.

To be measurable, statistics have by necessity enforced national economic tools that are comparable across nations. While this is a requirement for establishing starting points and targeting homogenization, it also imposes a normalization limiting original assessments.

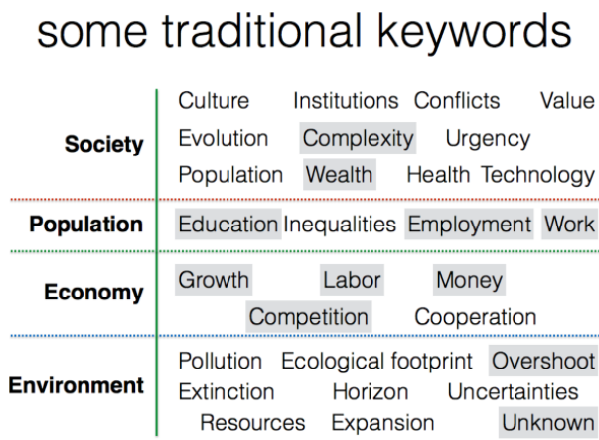


Figure 5.2. *Expanding the four SEPE representative model terms for understanding "growth" more formally. The greyed words are perhaps those with presently salient intensity, yet this depends on the orientation of the study at hand*

They should instead make both types of feedback loops plainly clear, and graphically: a shortage in rare metals may hamper the semiconductor industry, a cold day in winter causes a costly foreign importation of energy[4], milk overproduction will encourage dairy products or waste because of unauthorized surplus, etc. Because they don't, they don't close the loops, they remain open systems with a sense of "no conclusion".

The (first) Industrial Revolution epitomized this stage. It enabled wealth at a large scale, thanks to deploying energy-based machines and processes. An inter-system porosity increased as there was no other intrinsic limit to growth and influence other than the manufacturing and distribution capacity, even if as a response to an ever-growing and evolving demand. Such porosity imbalanced by the ever-increasing specialization of professionals of all kinds.

What's the most abstract model level for this stage of evolution? Possibly the mathematic "set theory"[5] along with propagation mechanics models and equations. Truly, everything gets assembled into sets: from nomenclatures to product catalogs, to everything ends up into groupings, just to be later divided, under sections, headings and sub-headings. Everything and everybody has got a title, and the whole "set" falls into computerized listings after ranking, sorting, and under another list and variety of kinds, genre, etc. Chunking sets is the post-modern "bean counting" procedure which we are all supposed to conform with under the principle of efficacy. Although set theory was coined in the 1870s, it was only introduced in western high schools in the 1960s! And we still unconsciously abide with it.

5.5. The ever-growing complexity

Late consultant Stephen Covey [COV 89] models three stages of human development:

1) independence;

2) dependence;

3) interdependence.

4 See the stunning interactive live map of real-time cross-border imports/exports of energy among European countries: http://www.electricitymap.org/?countryCode=FR.

5 From Wikipedia [WIK 17]: "Set theory is a branch of mathematical logic that studies sets, which informally are collections of objects. Although any type of object can be collected into a set, set theory is applied most often to objects that are relevant to mathematics. The language of set theory can be used in the definitions of nearly all mathematical objects".

Interrelations carry the weaker signals – those of change, yet need a culture of linkages to make them grow consciously. It is in the latter stage that we witness a sudden rise in complexity levels. For instance, individuals are using many identities (pseudos) throughout the many social tools they use across the Internet. They not only communicate but also coordinate among themselves and cooperate through many links and in many ways (projects, platforms, etc.).

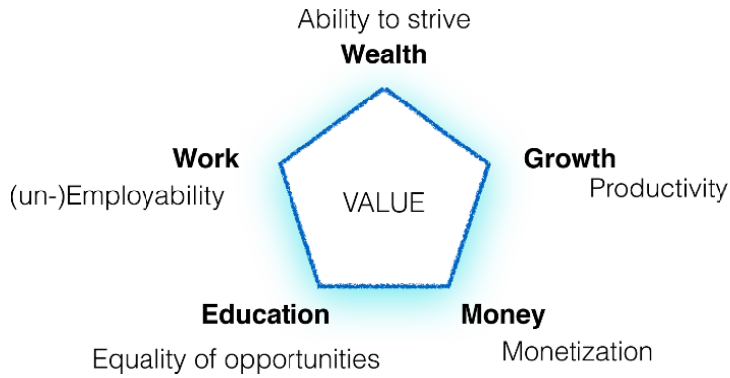


Figure 5.3. *Five domains which carry societal value*

Collectively, we have reached a stage where a discrepancy here causes a disproportionate effect there (to use the trotted out metaphor of the butterfly flight causing a tsunami at the other side of the world). Situational examples abound: policies about biomass or other alternative energies cause a series of oil policy changes; the complete design-to-manufacturing-to-supply chain process occurs in scattered places around the world; an accident within a nuclear reactor in a given place exposes to the world and makes shockwaves in government planning in far distant countries; a shortage of specific raw materials for semiconductors creates prices increases across the world; etc.

Future shocks (to use Alvin Toffler's highly inspirational "Future Shock" 1970 expression) promise even more scale up effects (such as a terrorist use of biochemicals in the atmosphere to name just one) as if they were those approaching singularities in our socio-sphere. A small group of individuals can now cause damage on a global scale in no time at all. A traditional face-to-face fight seems doomed because the simple precaution principle pushed to its limits would theoretically require the protection from the totality of would-be available resources, thus leaving nothing for anything

else operational. Note that Toffler interestingly related the "shock" to information overloading individuals.

And what to think of Bar-Yam's statement: "*Among the possible future organizational structures are fully networked systems where hierarchical structures are unimportant*" [BAR 97a].

What's the solution, if any? Is common sense and common wisdom enough? It theoretically would cover the problem if the problem was homogeneously and widely distributed, yet this is simply not the case. A single (worm-) hole somewhere on the Web and voilà!, an obscure backdoor is left open to some human, leading to potential global disruptions. It is consciousness that needs to develop because it only would seal the precautionary net and cover it with much covering redundancy, thus making void the need for direct-to-direct action. Note that this latter way remains caught in duality and we have long gone into complexity beyond complicated dual situations. The full-scale mastering of large-scale complexity in socioeconomic systems will surely take more years for able practitioners. Given all this transition, how to continue the journey?

What's in a crisis? A lack of adaptation, while emerging patterns and new orders lie in front of us. The story of innovation comes in to prompt adaptation. As the innovation charge intensifies, it becomes evident that we cannot envisage socio-economic notions as before. What does growth mean in a massively interconnected world? That we should only consider the offer-demand axis as before? That the interest of the individual gets the prime interest always? We have reached a stage where an individual decision alters a whole. Then, the whole alters back the same individual. Feedback loops appear everywhere and strike back without alerting. How can you easily decouple the sub-systems? When the subprime crisis was about to strike throughout Europe from America in mid-summer 2008, one bank (BNP Paribas) did dare sharply decoupling its European operations from the American ones. But it was just a little too late.

To remain caught along the individual–collective axis, yet an obvious duality reflects sterile discussions we are still having in politics and economy too: that we are caught in dualities. We need a third point outside that axis in order to resolve the problématiques, both in explicating and in acting. When considering individuals, we see a lot of variety and this should be preserved for individuals to develop with their respective capacities at their own pace.

When looking at the collective, we observe the common good and interest and this cannot be bypassed for long. It entails a different form of education, caring, competing, policy-making and governance to name a few domains.

As we favor dual opposite axes, we have to cope with the extreme facing polarities and resolve them in some *a priori* way. But here lies no synthesis, therefore it is not a sustainable solution. The way out requires to relate the individual to some surrounding collective and vice versa. How would you then conceive a governance that essentially works on these extended relations? The new leaders would favor relations first and we already see this factor in the newer generations having traveled and worked in several countries.

A striking example is the European Union's Erasmus Program which has been a huge success in the last twenty years or so, even if it has remained discretely advocated. It enabled deep multicultural experience for hundreds of thousands of young adults and infused a new "complexity molecule" in each young boy or girl who will never look – think at, speak for and act within – the global world in the same way as their parents and previous war-prone generations did. They have grown "hooks" on a myriad of subjects that make entire parts of the world resonate with them, mutually and growingly. Collectively, without necessarily knowing each other physically, they are growing a new organism on our planet. An irreversible process, unless a global catastrophe interrupts it. These are innovative programs.

As long as we view innovation as a means to sustain growth in economic terms, we are not building a bigger multidimensional whole, or are we? Innovation can also be seen as an *intrinsic* change, which leads us to yet another level.

5.6. Searching for a representation framework beyond set theory

How can we represent in a harmonious whole the key terms relating to societal growth that are listed in Figure 5.2?

What would be a representative mathematical theory to represent the structure of our current world as we experience it? We asked ourselves this question for a long time without reaching a clear conclusion. We first

sensed that the mathematical category theory[6] was more suited to model the observed evolution. This theory considers the *relation between objects* instead that the objects themselves (as would evidently do the set theory). The theory was conceived in the 1940s and still resists a wide dissemination and teaching, perhaps due to its apparently incomprehensible expressive form. But its power is genuinely overwhelming and the potential change it induces is uncomparable to set theory thanks to the fact it models everything as transformations (called "morphisms" in the theory). The basic concepts of category theory are: object, morphism, composition and identity. But it was only when knowing about Grothendieck's work in 2015 that we faintly sensed a way beyond. But this is uneasy to explain and requires some *a priori* development.

We were informed of Alexandre Grothendieck's legacy opus "*Récoltes et semailles*" since around 2000 (his unpublished text of about 900 pages) but we had to wait until 2016 to grasp the way to endorsing category theory in a sensible way. John Baez [BAE 16] explains that a topos helps "*to broaden our horizons and break out of the box that traditional mathematics, based on set theory, imposes on our thinking*". As an example, it helps to free the law of the excluded middle (either P or not P) without dropping axioms.

The way to reach growth will be reflected in the models economists, planners, and anybody construct every day. But in the classical theories of economy (and other theories as well), the sense of belonging of an object (goods, a player, a creditor, etc.) is fixed. By deconstructing this relationship, we can open new relations for every object.

Our formal quest can be summarized as follows:

> *How to model knowledge about "growth" in order to allow the maximum conceptual generative power?*

6 From Wikipedia [WIK 17]: Category theory[1] formalizes mathematical structure and its concepts in terms of a collection of *objects* and of *arrows* (also called morphisms). A category has two basic properties: the ability to compose the arrows associatively and the existence of an identity arrow for each object. The language of category theory has been used to formalize concepts of other high-level abstractions such as sets, rings, and groups.

We want to describe the "world of growth" without immediately naming the objects we conceive (because this is fixing the thinking). To be concrete, we would rather not be saying:

Growth depends on e.g. employment and pricing

but say instead:

Growth is a conceptual object that has relationships with pricing, jobs, employment, value, etc.

Figure 5.3 provides various "dimensions" having valuable qualitative and quantitative relationship to growth.

Jay Forrester was surely right when he said that "*whether in school or management education, the focus will be on 'generic structures'—a small number of fairly simple structures that can be found over and over again in different businesses, professions, and real-life settings*." Yet, he did not mention a method for *finding* such genericity. And this is what we have proposed in this book.

The big question is therefore which relation to put on a knowledge space. Depending on the filter we put on it (classical economy theories, systems dynamics theory, set theory, complexity theory, etc.), it becomes evident that we will generate different conceptual expansions. Here, the most abstract – a sort of all-encompassing generalization – is the mathematical notion of "topos". Toposes could arguably model the entire growth problématique but grasping it remains far too out of reach because the mathematics are at best arduous. *"It's so high a generalization process that it produces a different type of genericity!"* says Prof. Armand Hatchuel from Mines ParisTech when explaining toposes. Yet, we confess that in order to describe economic objects in the most flexible, varied, differentiated and recombinable way, and with a generative property, the notion of topos is the indication of choice. *"A topos is a rich way that associates content and the exploration of objects"* [BAE 16].

We concur and conclude here that our thinking ways – individual and collective, which are based on language – need to be adapted to the current evolution. And are in need of finding methods that change the mental models that are dominantly used by practitioners, decision-makers and the host of stakeholders.

Thus, the path to openness can no longer be the multiple forms of the "freebie" or other devaluing measures. The key to our quest – a sort of "perpetual economic motion" – is that extra spin for a new economy finally capable of surviving the disarray of a spreading uncertainty in which we live today, thereby regenerating growth. The conditions of use are:

– Vertical scaling: To be gradually applied to the whole economy to ensure that returns are maximized.

– Horizontal scaling: To be incorporated into all kinds of cooperative alliances through the polarization of all aspects of human life: economy, civil society and interpersonal relations.

– Personification: Be customized at will to tackle the diversity of stakeholder agents.

Although this is a comment that would require and merit further developments, a holographic model is slowly emerging, putting in reciprocal relations the parts and the whole, and relegating the old 20th Century causal models to the found objects by dynamically linking all the parts in interaction. The new (and fifth phase, according to some analyses) of economy – a fully-fledged co-economy – is thus under way. It is a co-evolution among the stakeholders, i.e. the emphasis is on the frontiers and relationships between the entities and the sub-systems which are evolving, and together.

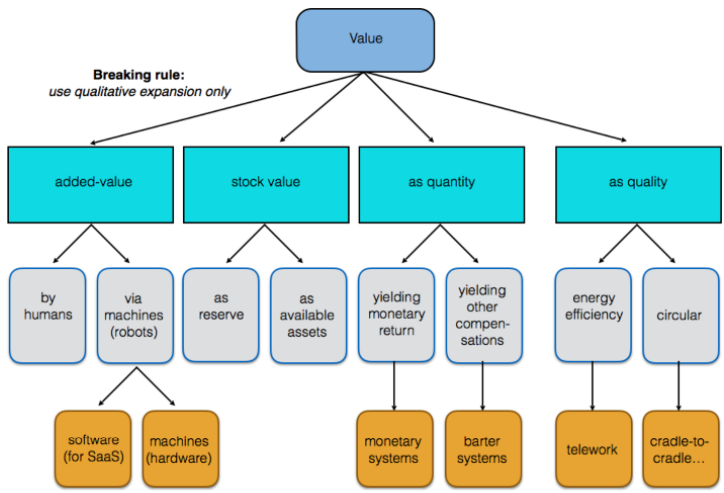


Figure 5.4. *A vast value potential opened as a result of deconstructing a root "Value"concept (examples of partitions only)*

Here the experience and knowledge of a sector (for example, within aeronautics) does not saturate the sector, but rather, pollinates other sectors (for example, the automobile industry) and vice versa; a phenomenon that is still all too rare in the innovation models of today. At the moment, biomimetic and bio-inspired approaches are expected to favor such cross-sectoral fertilization.

Crossing sectors leads to a vast untapped reservoir of unknowns. The repetition of successes and errors in crossing fields of experience makes room, not only for multidisciplinarity, but also for cross- and transdisciplinarity: a transitivity property of innovation models which enables a veritable source for repeatable, modelable innovations, which are themselves transferable. Thus, the level of innovative capacity increases significantly.

The subsequent Club of Rome reports, as well as the 1992 and 2004 updates to Limits to Growth did confirm the very same trends in various domains of economic, political and education relevance. How come we didn't listen to its initial clear message? The reason why the Club of Rome has not forcibly made headlines in the past interval, not even coming close in grabbing mass attention to a similar level that it did in the seventies, may be straightforwardly explainable: the models underpinning the world economic activity are still based on nominal resource growth sources *rates*. Rates hide the nominal: a problem of indicators? Sadly enough, at the same time the amounts are reported to fast become quite unsustainable (for example, the exhaustion of some raw minerals may happen within just one or two decades).

This results in a methodological oversight which regrettably wasn't much spoken up so far, possibly for lack of simple models. The underpinning models that were used cannot natively evidence how to break free from the limits of the past economical and industrial *habits*. Habits forge industry's practices, they sediment into categories of products and practices, that fall into as many industrial and economic references. These are built from the past operative fixations and will lead to evolutionary blockages. In innovation business, a basic paradox is that the more outstanding and lasting a success becomes, the more difficult it will be to change direction when the bell rings, due to competition or unsustainable by-consequences. And the later, the harder.

A specific consideration should perhaps be devoted to fixations. What are they? Mental fixations are a common cognitive phenomenon that creates a

sort of capitalization on past mind's constructs: cementing a view, a particular reasoning, an opinion, a position, etc. Which in turn may compulsively generate visible or not justifications and constraints the generation of new possible or plausible outcomes. The fixation effect can be seen as a predominant obstacle to a satisfactory design process at individual or collective levels because it implicitly prevents exploding the unknown.

If we were to ask what is a major cognitive fixation about "economic growth", surely many people may say that economic growth is about economy. This is true of policy-makers and also political forces in general: they view and measure an economic growth that is measurable because it is external to an observer. And of course they all are right at the effectual level. Yet, what does a causal level tell? Economy doesn't move by itself! It is the people who move it and the way they think growth reflects their own mental disposition about it.

Therefore, it is very difficult, if not impossible to crack open the notion of "economic growth" by not opening the mental box that has encapsulated it. If you want to make growth happen, do not work at growth itself, but work at the root of what may generate growth. And that is not economy! It is the mental disposition to open up new avenues for new activities that will root future growth. Growth doesn't go by prescription! Testimony is the hard attempts repeatedly made by many policy-makers and local or national governments for "force" growth in their city, region or nation. And that is sheerly difficult. Here is the main argument of this book:

Growth isn't a prescriptive, but a prospective issue

How to unblock the mental grip on growth? Defixation is a usual path to innovating and the concept–knowledge theory used in this book implements definition by systematically exploring the concept space through concept partitioning (an expansive mechanism that divides into disjoint sub-classes or expands into new classes). Defixing the concept of economic growth is about the principal subject matter of this book. If you reposition *individual people* at the center of growth processes, you defix from quantifying growth "externally" and propose to create new values around persons. If you position economic movement at the center you can spark a spiraling effect.

A new legacy is therefore called forth across the "economic growth" board at this moment in time of human evolution – without doubt made of an

overarching climate of uncertainty plus widespread socio-economic imbalance. A legacy that can bear distinct prospective alignment and resonance within the world society.

5.7. Shifting from problem-based to design-based methods

How easy is it to move on from the past? *"Old mental models and decision habits are deeply ingrained; they do not change just because of a logical argument"* said Forrester [FOR 95]. How to work out recommendations that alter behavior and help departing from practice-as-usual?

Measuring economic effects in the traditional way (e.g. via the dominant GDP indicator) is common, yet underperforming. Take two illustrative examples reported by The New Economist [THE 16]:

> *Should light be valued by the quantity or quality of lumens or only its consumption?*
>
> *Should a telephone call be worth time, duration, destination, or consumption?*

Light is something abstract, right? Same for a phone call. The answer to both these questions unmistakably reflects the background level of consciousness. And that level reveals the value level.

Should you be cost-conscious only, you are introducing a big negative shift in value: reductive to production. Furthermore, a change in something is not representative of value if it does not lead to valuable innovative effects. Thus, inefficiencies are transitive, multiplicative and aggregative! The same would be true for efficiencies, given an underpinning Moore's law in innovation.

The result is that economics do not tend to go with qualitative changes that introduce new values – a paradox, isn't it? Take accounting, a discipline based on costs and revenues: "potential worth" is not in the books, because a speculation. Only when buying-out assets, a speculation becomes feasible. Because of this, accounting remains "static science". But doing growth should somehow go beyond flatly counting the beans: we should become

able to gear up from the initial estimations. The business plan that would-be entrepreneurs document is supposed to specify this, but is often left aside when concretely operating a business.

Hence, a very restricted notion of GDP prevails everywhere as a tacit uniform law. Worth is excluded from GDP computations because it is both perplexing and hard to measure for analysts and economists. Yet, according to The New Economist [THE 16], tracking real income ends up in a failure as it does not "*account for the vast changes in the quality of things we consume*". What about tracking real growth then?

Today, almost solely underpinning the notion of economic *value* is the master indicator GDP. It is for this reason that we first seek to deconstruct it. We shall follow a design-based process by first eliciting the available knowledge about GDP in broad terms.

The *value* problématique retains full systemic flavor and calls for a "résolutique" of the same nature, i.e.:

– "at least" systemic;

– interdisciplinary;

– assorted with an holistic grasp.

Figure 5.4 is a simple example of an initial expansion of the notion of economic value.

The problem? That the reasoning behind can no longer be model-based as we lack the proper models. It therefore should be a design-based reasoning, with the aim to explore conceptual alternative ways for the future, along with the mobilization of the corresponding knowledge required. Several steps appear to be necessary:

1) disentangling the root causes of the systemic problématique;

2) obtaining a transitioning résolutique;

3) having the generated new dynamics capable of leading to sustainability.

6

Angling the Core Subject Appropriately

> "In any given moment we have two options: to step forward into growth or to step back into safety."
>
> Abraham MASLOW

This chapter is devoted to exposing a number of generic processes that can be exercised in innovation. These processes are divulged in a more symbolic than an analytical form: should we expose them in analytical form, we would limit their usage to a given discipline. They will all be used when tackling the core themes of this book.

6.1. Principle 1: find the "lowest lever point"

How can we proceed in taking into account the quest for growth in an innovative way, yet with all the constraints we've seen? A number of theories, models and techniques could serve to go past old limits to growth, but what about becoming innovative? Are there aggregative processes that rebalance competition and cooperation? By working on dynamics, we introduce an evolution over time, a dimension that favors a deviation from a straight competitive mode:

– collaboration followed by competition: this leads to the notion of "coopetition" and

– conversely, competition followed by collaboration, which leads to the notion of "comperation".

Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter, First Edition. Patrick Corsi.

Through cooperation, economic facts are managed in a wider space because the value of every stakeholder can be amplified. Each getting more recognition, the disharmonies can gradually be dissolved. Is this the end of competition or an evolved form? The essential point here is to reach a wider vision of a self-work. A work that becomes ampler and more harmonious. At the moment, we happen to enter a mass personalization of work.

What's important is to find the "lowest flexion point" and to use it as a conversion axis. Let's explain: the common error in innovating anything is actually to lever from "the highest flexion point", but you cannot jump by raising your head higher! You must instead take a position that pushes from the best bottom base. To launch a rocket to the Moon, exert a more or less opposite pressure towards the Earth (until you've mastered antigravity). This is the point where you find the strength to jump the highest. The push must be made at the low level.

Now, this was a metaphor, and we want to know how to build new growth, right? Well, the same principle applies:

A) Find what's the lowest point (semantically speaking) in the term "growth".

B) Deconstruct it by pushing it to the limits.

This will theoretically provide the maximum lever, actually the gradient. It's a generic principle applicable to about anything. It's a way to grant a new energy to anything under examination that flounders. We will use this principle by means of a specific terminology:

– finding the dominant designs of a concept (say, growth, work, etc.);

– breaking them at right points, so as to open up the widest space in the unknown. This is the initial step for a transformation.

Thus, you can obtain solutions to apparently difficult problems by finding a hub to stress as a fulcrum. After all, it's a variation of the Archimedes' principle we long learned at school, but forgot the lesson about it. The mental pressure should be acted not on what we want to obtain (this is where

the common error lies), but on what we are presently living: is it stagnation, de-growth, overpopulation, unemployment, etc. Instead, if we push growth, employment directly, we lack the creation of strength underneath, and it remains pure incantation.

6.2. Principle 2: divide to multiply

Now, there is an unsought variation of the previous principle. In arithmetic, by dividing a quantity, we can obtain a multiplication. In a concept space, this is called partitioning. There are two ways to operate a partition:

– A *restrictive* way, by breaking the concept into its dimensional constituents. This exhausts the possibilities, all subclasses are listed:

– An *expansive* way, by opening the process to diverse dimensions. We grab these "dimensions" by subsequently adding attributes qualifying the current concepts further and further. These attributes are defined from properties that can be expressed in terms of the knowledge gathered. It's like a generator of new concepts, a creation of new energy. This step opens into the unknown:

Everything in our daily life that has a name or can be named can be subject to these two ways of partitioning. It's a generic way to obtain results and becomes prolific after some practice. Note here that the partitioning presupposes diversity. The *variety* criterion is fundamental in breakthrough innovation: we seek to vary the character of a given concept every time we partition it. Variety will seed *originality*, which is the distinctive character of the resulting concepts we can later obtain through the expansion process. Variety and originality are the two fundamental criteria founding the exploration of unknown conceptual spaces.

This is why we always seek to explore the unknown: going into spaces which nobody contemplated yet, there lies much possibility for movement, away from fixations, away from saturated markets and clogged economies.

6.2.1. *An example*

Around the turn of the century, we noted we were repeatedly asked by a number of our leading customers, "*please help us innovate in services. What are the criteria, the new business models to implement?*" One particular sector did invest massively in coining the new models: the mobile telephone operators.

Basically, they've divided (time, space, message length) in order to multiply (billable chunks and profits). They've managed to fragment to the second the moments we communicate with each other, and thus built new valuable "communication moments" such as SMS, zillions of ready-made packages, and evolved them continuously. They've built an entire service industry where there was nothing but the generic scripted notion of a telephone call (dialing, ringing, taking the call, speaking and listening, hanging up).

By dividing the dimensions of a call into units, they've built immense value, new jobs, new companies. They've also redefined the frontiers between analog telephony and the digital world. They've opened the way to a world of instant, ubiquitous communication. Yesteryears were a world of sole products. Today is such an intense service activity. Tomorrow will see many more of the same, new service industries in many domains of economic activity. The push will come from the further automatization of industry, cognitive robotics, massive and deep data analysis. Many job profiles will leave the way to algorithmic mechanisms (i.e. software robots), and many new profiles will appear bearing far more economic value. Growth happens through a systolic mechanism, dividing for multiplying.

6.2.2. *The overall scheme*

Should you point to the max, you will obtain the min, while should you point to the min, you may obtain the max. And this is so given that pointing to the min requires the minimum energy (physical or mental). Thus, the energy can be used for the later step: to aggregate the resulting concepts into a true project – a project proposition "movable" through society or an organization.

The aggregation phase is like a gearing process that moves the organization (a firm, an institution, etc.). It's the phase through which we

can claim having obtained something. Something that creates a tangible movement.

Let's recapitulate:

1) K Phase: to gain this multiplication effect, it's first useful to having revisited the knowledge domains that apply. This we call the K phase or knowledge phase.

2) C Phase: to expand into the unknown is the conceptual partitioning phase that we perform by adding specifying properties as conceptual attributes.

3) P Phase: to collect, aggregate and picture the propositions back and project them into a realizable space. The aggregation phase P is like a gearing process that moves the organization (a firm, an institution, etc.). It's the phase through which we can claim to have obtained something. Something that creates a tangible movement.

6.3. Principle 3: going from the "two" to the "three"

A "two" here means two alternatives in direct opposing rapport. We can find "two" thinking in most of our life sectors: the measuring of anything along a directional axis, political orientation and the overarching quantitative reasoning (which leads to benchmarking, comparing and grading).

In "two" evidently resides an inherent duality. Duality triggers a tension between opposites, stirring negative psychological phenomena. One is fear (of too much or too little of something), another is stillness (preventing from either extreme).

By escaping from these negative traits, we qualitatively widen the duality inherent in the "two". We build a sort of alchemy that "builds" a new value, a return. The return may be anything, including monetary. That is the "three" thinking way: to open a third space point whose return may be bigger than the original. It takes altering the mental structure to enter in a world of the "three", which is a new energy.

Practically, playing the "three" is often making room for opportunities not considered before. Becoming conscious of them, thanks to a mind

process that allows their consideration. One serious question we have found when practicing field innovation business for firms and institutions is to stimulate the minds of the people present in the innovation process in such a way that the people "let it flow". Literally, your mind is your "laisser-passer". That is the job of the coaches who are able to trigger proper flows incentivizing evolution and innovation. And there lies growth at the root.

The right job entails favoring the amplification of horizons (the four-stage method above is key; therefore, the thought gets amplified and can explore the unknowns). There are more virtues coming from the "three" model. When working collaboratively, the communication freedom that installs meshes with other's thoughts instead of facing them enables going further than these. New paths are built that are constructed by everybody, hence:

– they get true collaborative support and

– escape the heavy normative thinking way that is often superimposed by the existing state of things.

The paradigm that is being described is one in which we formulate a mental construction that says that anything becomes possible constructively by the way of doing it (not speaking only of it). Further, the trace of the logical reasoning and exploration path is a solid and retrievable backup that has several virtues:

– it removes the fear of doubting, of uncertainties and

– it links and glues the piecewise concepts obtained together in *robust* path sequences feasibly actionable in the knowledge space (*robustness* is the third basic criterion). Everything adds to everything, nothing remains fragmented.

In the "two" thinking, we are induced to think small, to think in little, small quantities. Because it's built on give and take, on compensating something (zero-sum game!).

In the "three", we open the thinking space so much that we are induced to thing big, many, in the large. When escaping polar opposites, these never meet; they are transcended, they generate another level of energy. It's a give + take + gear. We have renamed it conveniently to:

Give – Get – Gear (3G)

Figure 6.1 depicts the spring-like dynamics enabled through the level effect of a "3G" mechanism.

The model is equivalent to set an open "response upon request" mechanism that far extends the traditional offer–demand closed model. This is the fundamental bifurcation point for a future "science of growth", branching to an economy of radically new abundance. And it's all based in the brain – however, with a method.

The next question is *where do you put the most value*?

I would advise you well to place it in the Gear box! Because in so doing you shift the whole thing into the new. Until you account things with a give and take, the value is stable. Contemplate the Gear and obtain value beyond value. Note that *value* is the fourth and last criterion we fundamentally consider in this book. Mathematically, all you do is to play the "three" and it's like operating in a new frequency yielding vast new returns: dynamic, augmentative, always spiraling up.

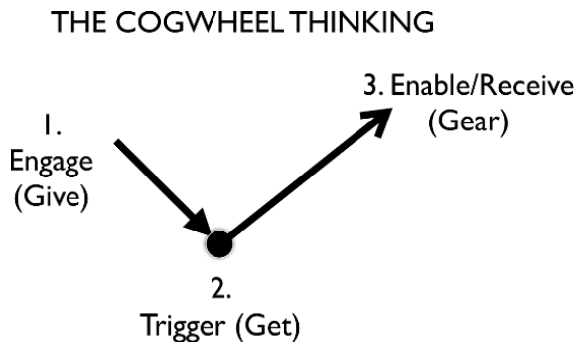


Figure 6.1. *Setting an organic movement for growth through a three-pronged "3G" mechanism Give – Get – Gear*

This is the place where we would offer a criticism of the "circular economy". We consider this model as a sound initial model for creating, not augmentative returns, but *efficient returns.* Since it closes the circle, everything returns to a new start – statically. Open the circle and make a spiral that goes out to touch many "three" points, and you obtain the augmentation in the returns you expect, and so on. No theoretical limit because you aren't bound by matter here. This is the augmentative "spiral

economy" we would propose as a wider model to the circular economy. The former encapsulates the latter as soon as the principles of circularity on products, services, process, models, etc. are obviously taken up.

The right zones to invest are all located in the "three" spaces. It's a way to act without fear, in connection with everything. Always check the availability of "threes", call for them, experiment with them.

A more compact society can be generated through these mechanisms, with a number of virtuous effects:

Virtuous 3G effects

– feed confidence;

– foster fraternity;

– recognize talent;

- which can turn into capacity, ability;

– short loops (consume close to production);

– auto–sufficiency;

– interpersonal relations;

– abundance (not scarcity).

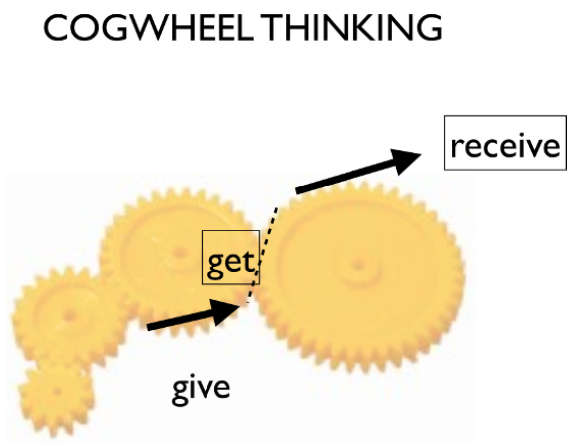


Figure 6.2. *Engaging momentum through a connected series of "3G" mechanism models*

6.4. Practical considerations

A mind-level coach would immediately detect if a person acts in "twos" or in "threes", the latter being much rarer at the moment. The use of language is revealing. For instance, most people give value to money – a high value actually. But how much value do they grant to themselves? If they would train themselves to consider themselves (thought, speech, action levels included) as part and parcel of what they externally do (job, relationships, creations, etc.), then they could no longer separate themselves from what they value – hence give a value to themselves! They would not depreciate themselves any longer, and would strive growing value just everywhere, in everything! No longer obsolete or on rebate!

Figure 6.2 shows the combined gearing mechanisms obtained by synchronizing several "3G" mechanism models.

Methodologically, and for each 3G step, it is important to clarify three things:

1) To define the starting point as a couple:

– a foreground operational concept C0, as a proposition with wished properties (i.e. non-existing yet). This may be feasible or not, alternatively remains undecidable;

– the background situation status, assorted with a SWOT analysis, mobilizing available relevant knowledge about the seek concept.

2) To monitor progress along a development, which reflects the priorities and may not always have a determined goal. Since the 3G model is imbued with an innovative idea, the *a priori* setting of a goal may not be feasible or always advisable.

3) To qualitatively and quantitatively measure the yields, tangibly and intangibly. Benchmarking should not be the sole management instrument and by far, as spiraling effects may enter and occupy previously unknown zones of activities and effects for which a measuring frame is not available. Good practices are always useful to document and share, for many original economy experiments still remain at the local level without scaling up, thus hampering the sharing and limiting their credibility. An example is the many alternative currency experiments in use throughout the world that are only played at city or small community levels. The question remains as of how much of the activity generated by these alternative economies can be and are accounted for

in national statistics. Such activity may amount as non-observed sectors or informal sector, which is just a word for non-counting a contribution in the national accounts. Diane Coyle [COY 14] recollects, among other examples, the extraordinary jump made overnight by Italy by including the informal underground economy through a relabelling of its national statistics.

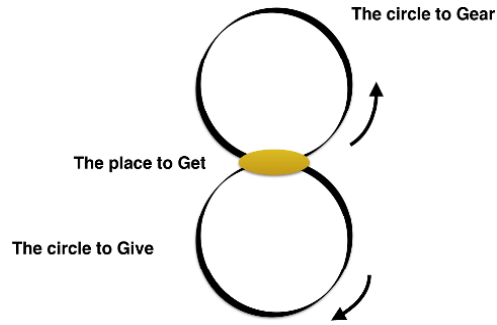


Figure 6.3. *The transformative point around which revolve the "3G" mechanisms plays an essential role in redirecting the dynamics. It can be an individual, a firm, an institution, etc.*

The question of using indicators is always present in the background and would deserve entire studies. What we wish to say here is that they reflect the dominant thinking about value, value-added, innovation, etc. For instance, national statistics often consider that innovation is the result of technological development. But this is far from reality! Today, innovation spans entire realms of activities, such as:

– a marketing method, a business model and

– an organizational method, a workplace organization, a business practice.

Actually, just about anything that embeds knowledge can be subject to innovating. Innovation is foremost a mental process altering a status quo (about an "object"). We consistently consider the following four generic indicators for valuing innovation:

– originality;

– variety;

– robustness;

– value.

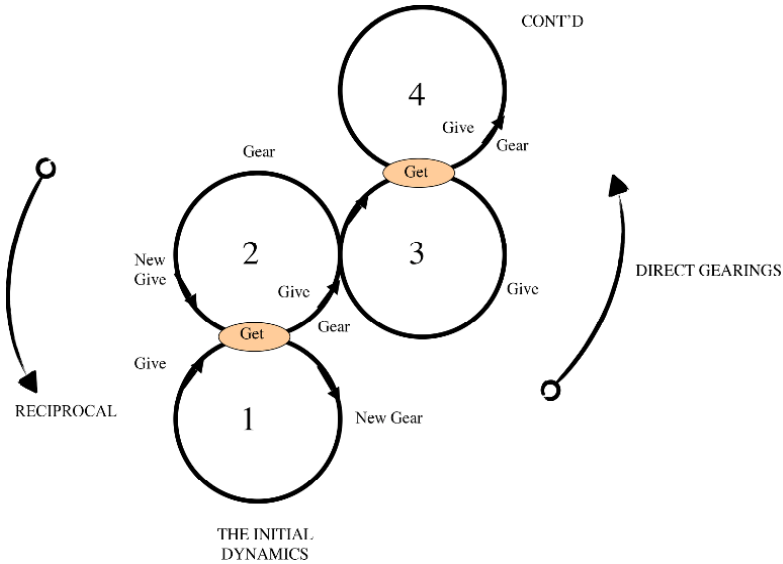


Figure 6.4. *How a three-pronged gearing model works, developing a potentially infinite spiraling mechanism*

No wonder statistics about growth tend to expel the vibrant activities related to the above-listed domains (which aren't even entries in the NACE classification!).

Figure 6.3 details the transfer mechanism that can engineer a spiral economy; note the difference with a simple transactional model in use today everywhere.

With the above in mind, there is room to develop a "growth capacity building" within cities, regions, countries and communities of member states. Figure 6.4 exemplifies an ever spiraling process of growth progress.

6.5. Case: reflections from a Haitian context

A personal experience with the Republic of Haiti illustrates the concept. We were dealing with various innovation projects involving both Haiti and Santo Domingo. The economic differential between the two countries is very high; yet, they both partition a same island: Hispaniola. Their economic discrepancy isn't cyclical, but structural. Haiti lacks a number of

infrastructures to sustain a productive economy. Scaling up local and personal exchanges remains difficult as well as widening economic movements.

And the national policies remain insufficient to fluidify the movements if, for instance, the structures remain too rigid, the coordinating instruments too weak, or, as it is the case in some well-developed countries, there exists a tendency to continuously reform what exists already. Reforms may bear a less positive meaning nowadays, as they aim more at regulating, less at flexing. What's necessary is to disseminate a "monetary lubricant" in the economic tissue.

Beyond these observations, a neckbreaking competition aiming at lowering value ever doesn't accrue to positive yields: it holds a risk of legitimating social dumping and of detaching value from the goods created, a deathly act. Liberalizing markets seems altogether necessary to continue, still through level-playing fields, i.e. with reciprocal principles. Note that the natively networked industries (e.g. the post and telecommunications) are central in the process: every living person is by default a customer of the Post since birth! (and sometimes even before…).

From a point of view, a state policy mix attempts to promote novel macro economies. This isn't enough if the citizen risks being separated from the movement: when a person is too far away from the production dynamics, you create a variety of negative feedback loops, ranging from demotivation to rebellion. Not only a person's talent, skills and competencies, but the inherent features of a human being (consciousness, intuition, and awakening to higher values) need be stimulated to obtain a harmonious development (the old Maslow pyramid of needs being an archetype of such a development).

A transformative point is required from a proximity to the citizen and the individual in order to create a significant flexion that can be multiplied. The exchange between demand and offer remains a closed model, with an unbalance between:

– the productivity and the interpersonal dynamics (among which lies the entrepreneurial dynamics) and

– the incomes and their growth.

6.6. An asset base for growth

Who shares the growth? An answer is required that provides the stretch of the asset base. Should globalization reinforce those entities of major strength only and weaken the others, we would have the recipe for an imbalance leading to systemic instabilities. The economic rules were defined at a time when positioning within limited spheres of activity. Today, a necessary internal and external agility, the massive use of communication means, a globalized commercial activity, all call for a recombination of the ancient economic model parameters. New dimensions are called forth that are reflecting the openness made possible by technology.

Assuming any entity – which can be a physical person, a moral corporation, an "electronic person"[1], the latter including connected objects – can actuate value by some mean as a node in a network, thus actuating the following elementary growth seeding mechanism (Figures 6.1 and 6.3).

The replication of this "elementary growth engine" (EGE) for each node in the network leads to spiraling effects, whose development actually follows an exponential development curve, both qualitatively and quantitatively. To obtain such effects, a proper governance shall be installed that opens up and guides the EGEs at the same time.

In this three-pronged model, it's always key to have a circle that Gives and a circle that Gears because should you interrupt the Give from the Gear in any possible way and also in any manifestation, you will miss the payload that recharges the movement (and hence the growth potential doesn't transform into kinetic activity). It is an energetic process, and if the payload energy is absent (as in the dual economic models of give and take, mere offer and demand), you won't be aligned with the potentials of becoming and remaining stalled, deprived of evolutionary patterns. Growth is not an arithmetic concept! Growth is an evolutionary concept indeed.

1 The European Parliament developed a world premiere guidelines draft for defining artificial robots, alias "electronic persons" in May 2016. See https://hardware.slashdot.org/story/16/06/22/217205/europes-robots-to-become-electronic-persons-under-draft-plan).

We have occasionally published on these arguments; yet, there does not seem to be much global research despite marginal formulations. We found that man was not ready to jump into a ternary model probably due to the dominant cognitive fixation that prescribes dual models everywhere in analytical encapsulations. Human brains' inductions are to think in limited ways: the ways of balanced transactions. And truly enough, the transactional world is built on closing the transactions, hence neutralizing the growth potential. We published a paper prefiguring the blockchain transactional model right in 2005 [LEV 05] and insisted on the shift from a Moore's law model to a Metcalfe's law model of operating in networks' value space. It showed the powerful economic expansion that networks consent with respect to playing them.

6.7. The exponential movement

Signing up to the "three" allows opening new doors leading to new recursive economies. There are several ways to express the power hidden behind these simple numbers. For instance, if I give you the following series of numbers:

1 2 4 ?

and ask you to select the following number that best applies in your own thinking, this will likely reveal your propensity to play ternary models or not. I proposed this quiz to many students over the years, usually at the Master graduation level. And to Haitian students in 2009. One Haitian student, after a little pause, unexpectedly uttered a blunt "128"! It shows how exponential you can become, independently of the stage of economic development of the country in which you live. The "gear" exponent that you use repeatedly in between the initial three digits and carry over is the signature of your thinking way. Thinking big is not necessarily seeing larger-than-life pictures. It's also grinding what's before us with an exponential grind.

It's an infinite journey of the mental process out there: expansive production processes in any field, be they organizations, alliances, partnerships and any form of cooperation in every sector. Including at

interpersonal and group levels. It's a direct way to add value to the value of who has and gives in every field. Every added value becomes the root of another expansive process as a start-up engine. As it progresses, more people get involved and involve other people, and so on. The circle initiates with the gearing and ends up with the distribution.

The following sketch illustrates what could spin an economy when everything's moving:

Moving the economic activity

– growth as movement

- with geographic movement

- by keeping resources in circulation

- by access to products and services mobility (by replacing ownership)

- from Buy&Own to Use as a Service (UaaS)

- by replacing delivery by performance contracts

- Example: medium-arrives-in-time (e.g. a train) versus passengers-arrive-in-time

- by shifting ownership

- by leasing fixed assets

- by living on cash flow (and not fixed assets)

- by dematerializing assets

- with data

- through (online) presence

– cross-people movement

- through sharing (= collaborative) economy principles

- by redistribution of product usage

- redistributing excess of goods or services (pay per access)

- by pooling goods (cars, etc.) (pay per use models)

- through access to the? value by outsourcing work in-the-large (i.e. crowdsourcing)

- by producing more value from fewer resources
  - by increasing aggregate efficiency and productivity
- through an IT/IoT infrastructure
  - that reduces marginal costs to near zero
    - of producing
    - of distributing

6.8. The economic equation

This is where to work at: how to make a product, a company, a society that produces the spiraling yield, without end. Many gearings encapsulate one another. An infinite return process that produces returns for anybody in between. We are far from the arithmetic intermediation of a traditional supply chain. It's an assembly line of an exponential order, which moves the parts and creates augmentative returns ever and ever. A movement of who produces, who gets and who gears up.

How to provide a return for anybody who "gets"? Imagine these imbricated and interacting eight-shaped circles: you have eights everywhere, each having an outlet at the end. You obtain a distribution model. Then the distribution process moves another one, etc. This is a true circular economy, actually a spiraling model that frees every single agent in between from the heaviness of the whole process.

6.9. Relationship with SDGs

Gross domestic product (GDP) is traditionally driven by labor and capital. More recently, energy is considered as the third component of the economic process, notably by Jeremy Rifkin [RIF 11], who believes it represents a critical driver. Evidently, energy can in principle amplify economic developments. Yet, what about the material resources, including the raw material used? Even if energy were free to obtain, we remain confronted with the same conundrum of exhaustion of material components.

Due to an over-complexity that has grown noteworthily intractable, the acceleration of history – it happens, largely based on technological developments – compels the seeker to shift the PERIF[2] bundled set of issues to a more ontological field of inquiry. This can be based upon the "WEG" set of global concerns:

Work – Environment – Growth.

These issues not only intersect, but dynamically intertwine, creating a new post-modern nexus of complexities. Second and further orders of dynamics interplay in new whirls of becoming, which could not be attended to by Forrester's and the likes' approaches. For instance, artificial life and robotics do have an impact on work and labor already, and their promise is to challenge both productivity and social laws (see the EU Parliament draft report [EUP 16]). Novelty is in the capacity of an approach to be able to deconstruct old concepts, then regenerate them constructively, with a view to seeding alternative regeneration paths for the society at large.

While technological change is pervasive, boasting straight digital directions, the unsustainable hits of humanity haven't made the planet immune to Earth overshoots. Past models end up being too brittle for today's levels of complexity because the models behind the curves now depend upon far too many parameters; they therefore aren't enough to further operate efficiently. Complexity prevails everywhere and upfront, boasting wicked problems everywhere, many of them reputed intractable by decision makers, who are daily facing situations unsought before. In politics, hesitation, disagreements and fragmentations prevent leadership. In industry and economy, chaotic environments making strategies uncertain at best. In social realms, permanent unrest stifling organizations.

The planet, the civilization and the human species are debated (as people debated local governance a few decades ago only) and are considered to be at stake. While we happily have the set of the 17 Sustainable Development Goals [SDG 15], representing as many targets chartered as global drivers, who can yet understand their dynamic interrelations? A race to the twinned rescue for man and planet has begun, raising a sense of urgency. The question is how to discern the relevant directional paths that can lead to

2 The five Peccei fundamental factors studied in the 1972 report from the Club of Rome: Population, Environmental degradation, depletion of non-renewable Resources, Industrialization and Food.

crafting the next few steps for humanity's development? Because by now, the ever reachable target is probably curtailed to discovering implementable paths and is no longer pursuing theoretical goals. A way of the Tao catching us by mere necessity, if not by total surprise?

Goerner, Lietaer and Ulanowicz [GOE 09] explore what it takes to ensure long-term economic health, robustness and sustainability. They show that the economic system must maintain a vital balance between resilience and efficiency, two factors that are complementary. Their finding allows them to quantitatively differentiate from mere growth. They showed that emphasis on GDP growth (with, for instance, positive feedback strategies) favors large, highly efficient companies (those having greater economies of scale) with detrimental systemic consequences to the smaller and more diverse, local enterprises where jobs can also be lost. For them, what matters "is not how big you grow, but how you grow big" and the refraining from excessive, single-minded pursuit of e.g. efficiency and GDP growth. Only by adopting and enforcing systemic views and models can we mitigate the collateral damages of pulling too hard GDP growth unilaterally. The problem is that the (collateral) cost may, at some point, unduly increase to create adverse feedback effects for the whole system. And this has triggered famous authors to declare the planetary situation doomed (such as Dennis Meadows, "*It is too late for sustainable development*" [SMI 12]).

For them, "*the same laws of growth and development apply both to natural flow systems and economic ones. This notion rests on a thermodynamic hypothesis with long historical roots in ecological economics, namely, that similar energy concepts and network analysis methods can be applied to all matter–energy–information flow systems because, as Systems Science has long observed and Prigogine's (1967) work in Self-organizing Systems confirms, such systems exhibit strong parallels in behavioral patterns and developmental dynamics.*"

By implementing the theory of complex flow systems, these authors form parallels between:

– natural ecosystems, which are deemed sustainable (enduring, vital, adaptive) and

– economic and financial systems.

By which theory the structural diversity and interconnectivity property entails ensuring a balance in emphasis between efficiency and resilience. Energy efficiency: is it doing more with less or better with less?

It is therefore important to be able to transmit an economy that can be linked not only to the rational mind, but can also be in resonance with that part of internal justice, meaning balance, fairness, actually systemic equilibrium.

7

Cracking Open a Growth Concept

> "GDP is not a good measure of economic performance, it's not a good measure of well-being."
>
> Joseph STIGLITZ, Economist

7.1. On the presence of dominant designs

Before starting, it is necessary to recharge a relevant growth knowledge base, and for this, we'll first work on pointing at the so-called dominant designs about growth. The design principle we follow for the subject matter, "growth", is to force a radical departure from the dominant designs of our times, past and present.

Dominant designs are those consolidated arrangements that industry progressively stabilizes for its objects as a structuring reference and with a view to organizing trade. They reflect the "way of the day". A few examples: a car has four wheels on the road, software interface menus tend to have scrolling bars, a typical vacuum cleaner has a dust bag fitting inside, etc.

Any mature market shows these conventions and common practices as means to make the offer–demands relationship readable and stable. Dominant designs are a necessary order, an unavoidable maturation, and increase the trust and confidence in given market segments. They are a translation of a dominant thinking: the means used in reasoning in the face of contextual diversity (competition, markets, etc.). The cognitive orientation

Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter, First Edition. Patrick Corsi.

that is reflected may evidence cognitive bias (i.e. mental posts) that refrain us from considering alternative ways of thinking: e.g. the usability criterion for operating machines goes by many standards found on all products (e.g. a five-gear lever or the position of the brake for a car); majority voting being customarily used, etc.

However, two problems often appear when these governing dispositions grow old:

– Nobody can explain why the object is made so. Those who designed it have moved or have retired and the background knowledge motivating it hasn't been documented consistently. People tend to go by the dominant rule without knowing why. This may have a cost or may prevent them from improving the situation, for instance by simplifying a design (often it gets more complicated with good reasons!).

– Following new demands and improvements, the accumulation of new features around a dominant design adds a level of complication that may mask it. The (added) trees hide the (original) forest. The complications surrounding a simple fix get all the attention but aren't the key points.

These situations are as common in industry as they are in policy-making. Governments' reforms do not always simplify a present state of affairs but add more inertia to it. This may lead to deadlock situations. This explains why it is not always simple to simplify a situation: this requires an understanding of the roots of the problem at hand. Which may require one to go back in time to the origins of a decision leading to the problem (not a direct causal link however), or to trace back the reasoning that led to a current assembly.

Cracking a dominant design usually requires working on knowledge. This is a way to regenerate dynamics from its breaking. But breaking a dominant design is best done by first defining it with sufficient precision. We do this by looking at things "diagonally" and not facing them. A degree of X-ray-like observation is typically useful, and we grow this capacity by taking a step back from pure observation of the relevant knowledge.

Now, the key point is that breaking dominant designs in proper ways can unlock the tacit arrangements of markets and their objects, which opens the way to uncharted exploration spaces (defining so-called breaking axes). It's an inroad into the unknown. When designing breakthrough innovations,

a productive approach is to break certain dominant designs, those that hamper an evolution with benefits.

The following frame represents a typical partitioning of what "classical growth" may represent. The indented list reflects a tree structure that usually comes out of working group sessions.

Classical growth

– through fixed assets
  - material assets (physical)
  - "who owns what"
– through consumption
  - by (long) supply chain
– through ownership
  - guaranteeing wealth and status
  - bringing stability, independence
  - bestowing power
– exploiting resources
  - natural (unnatural growth)
  - human
  - financial
  - technical and technological
– needing growth calls and incentives
– needing competitiveness
– dividing and antagonizing
  - dissociates producer and supplier
  - opposes give and take

– working on maximizing price–cost disparity (PCD)

- price after transformation

- cost of transformation

– where the support is outside

- a third party (acting for trust)

7.2. Some background knowledge relevant to GDP

What is gross domestic product (GDP)? How suitable is it as a measure of prosperity? It is supposed to be related to (the ability to get) jobs, consumption and production, but is fundamentally based on markets (Adam Smith). How about social, behavioral prosperity? It is related to money. But money does not rely on economics! It has become a technical mechanism, an end in itself. A rather hysterical relationship to growth. An eternal GDP formula for all, everywhere. Economic stability is still founded on Adam Smith's assertions (stabilization through competition). GDP is an ideology – the difference between maximization and optimization; maximization: as a goal, optimization: the goal of a source of ideas.

The design principle we follow is to obtain a radical departure from the dominant designs observed for growth. This leads us to focus on GDP. This will be done as follows:

(This section contains enhancements of extracts from [THE 16])

GDP was introduced in 1932 to estimate past US national income. Keynes in the 1920s: the sum of private consumption and investment government spending (including foreign trade) (government spending was a cost initially!). It was launched at the time of farms, production lines and mass markets to capture the production of ever more stuff with aligning markets. During war time, GDP was a way to manage supply and in the post-war period was shifted to manage demand – an undesigned flexibility for such a raw measure! GDP adoption spread across nations, as they wanted to receive post-war US aid (Marshall plan allocations were made against local GDP). It is made clear by [THE 16] that GDP "*is a measure of production, not welfare*" and "*much that is valuable is neither tangible nor tradable*". Interestingly, the traditional notion of work follows these specifications.

Gaudin [GAU 10] expresses the dominant role of GDP as a designed proxy for wealth in these terms:

> "*Many criticisms have been expressed against the standard economic way of thinking but up to now, the rules of the game stay as they are and the GDP is still considered as describing the 'wealth of nations'.*"

He further details what makes GDP a dominant design in itself:

> "*The standard way of thinking is often characterized by a focus on trade, although trade does not always reflect wealth but, using an econometric model, it can be said that 'Concerning trade: the difference in growth rates will lead to significant changes in world trade distribution. China, already considered as the workshop of the world, should take an even greater share in international trade, from 7.7% to 15.1% of world exports. Comparatively to Europe, the USA should lose less export shares. This is mainly linked to the fact that they have relatively more relations with fast growing regions.'*"

Should this be deduced from GDP? We understand that GDP was initially a survival measure; it could not take account of depreciation of assets, pollution of environment, or human accomplishment for example (what's the GDP value of the Solar Impulse project?). Robert Kennedy exclaimed an idolatrous respect for GDP in 1968, which measures advertising and jails but does not capture "*the beauty of our poetry or the strength of our marriages.*"

Actually, the value added in an economy (possibly adjusted to inflation) unfortunately remains a conceptual view, actually intractable: "*it requires the value of what is produced, net of inputs, across a wide variety of business lines.*" GDP is clearly adapted to manufacturing and does not measure innovation (new products are hard to take properly into account). "*It also runs into problems when quantitative changes get so large as to become qualitative.*" "*Adjustments are even harder for services.*" By definition, GDP excludes free-of-charge goods and services (e.g. voluntary service).

Gaudin [GAU 10] asks and discusses an interesting question – "*Is GDP growth inevitably generating energy consumption?*" – and proposes both

examples and ways to reduce consumption in manufacturing, households and transportation with appropriate technologies. He concludes: "*Before 2025, the GDP growth question may leave the place to another more fundamental question: how to account for a realistic wealth indicator?*"

All these GDP definitional shortcomings have grown an unfortunate yet politically controlling inability to track wealth, even more so as innumerable tangible offers which were products are transformed into services (i.e. a map is used electronically instead of paper-based). As the clear trend is towards a bigger proportion of digital goods with respect to material ones, the notion of GDP loses value and meaning every day. And "*it is a big mistake to think that one number serves for all purposes.*"

All in all, the concept reveals many conceptual fixations of an old age. Today, the economy is dominated by (mass personalized) services and replaceable products, where user experience is paramount. For years, the GDP measure has been far from the real picture, and continuing to use it may in part elucidate crises ("*all crises are inter-linked*" [VAN 16]). And, to close the matter definitively, the notion remains blind to the essential mix of factors underpinning sustainability!

Goerner *et al*. [GOE 09] are quite clear with the premises founding current economic views:

"A great deal of current economic theory rests on the assumption that economic laws, such as standard supply-and-demand dynamics for example, hold regardless of the resilience of the underlying networks". Similarly, as Cobb *et al*. ([COB 95] cited by [BRI 03]) and others have pointed out, today's primary measure of economic health, GDP growth, only counts the volume of monetary exchanges and ignores whether such exchanges go toward building economic capacity or paying for damages, liabilities and unproductive debt. GDP growth actually masks declines taking place in various parts of the economic web by allowing massive gains in one sector, such as hedge funds, to be conflated with health for the whole. In retrospect, this blindness to network health rendered much of classical theory incapable of understanding, much less predicting either bubbles or the kind of widespread economic instability that now threatens the world." They note that there also exists jobless growth: "*meaning an increase in GDP growth that is accompanied by a decrease in living-wage jobs.*"

7.3. Discussing GDP features

The notion of GDP reaches limits within complex environments. It is solely an economic measure, being challenged by new forms of economies: blue, circular or eco. We've discussed that competition is not enough and the notions of coopetition, comperation and even emulation are extending it. Nash equilibrium is paramount (REF, New Economist, June 2016):

(Max (Pi) / Max SUM Pi)

Variations from GDP have been attempted. One is the gross national happiness (or GNH) based on Buddhist values. It has been promoted, since 1972 by the king of Bhutan. GNH revolves around four principles:

– promoting equitable and sustainable socio-economic development;

– preserving and promoting cultural values;

– conserving the natural environment;

– establishing good governance.

The United Nations promoted a "human development index" and ranked countries in 2007 in this order: Iceland, Norway, Australia, Canada, Ireland, Sweden, Switzerland, Japan, The Netherlands, France, with the USA ranking 12th, UK 17th and Germany 22nd.

7.4. Evidencing past GDP's dominant designs and breaking axes

In this section, we elicit a collection of dominant thinking points (or DDs) that are commonly attached to the accepted notion of GDP in the economy and in the society. The breaking axes point at novel directions available to offer a way in which to break apart from a given DD with a view to open new radical ways that bear new value (value having the possible meanings seen above).

Together, the dominant designs listed above tend to express a rather archaic vision of what economic development may represent for a given

post-modern society[1]. The fast-stretched – and still progressing – digitalization of our economies and individual lives compulsorily engages the valuing of contents (products, services, processes, conducts, etc.) that carry an added value. Today, it is necessary to develop and harmonize the global indicators of wealth and measure of economies at large. Standing still – i.e. continuing to measure the transformation of the human world by the yardstick of GDP as the measure is like counting the beans in the box and giving away the recipes that can be made from them. This is a call for an augmentative lean economy, whereby any valuable product, service, process, etc. (1) should be thrown in an economy and not discarded and (2) contribute to an augmentation of the resulting value for stakeholders.

Their high number is a surprise, and no wonder a continued quasi-religious adherence to such an old notion may be detrimental to the regeneration of society. As a synthesis of the dominant designs above, GDP as a concept is already misleading decision makers in mass economy.

Yet, the analysis made above does not mobilize the wide ranging nature of what composes human beings. Should it refer to aspirations, and superior-ending values (which would have to become reflected in a post-Maslow pyramid of values), we could perhaps obtain the following set.

7.5. A framed template for “new growth”

This frame opens up a number of expansive concept ideas for envisaging new sources of growth. Still a tree structure, it could be represented by a conceptual chart like a mind map(™). However, it isn’t a flat representation, but is intended to partition a “new growth” concept in an expansive way: each branch signifies the opening up of a dimension for further expansion.

The format shown here serves to illustrate what usually comes out from group sessions with participants. It shouldn’t be seen as a definitive and closed structure at all, rather a sketch for progressing further.

1 Think of the the dead capital: house owners without property documentation – 10T$ yet to be monetized! The foregone gains that people and businesses in the informal sector surrender to their counterparts in the formal economy: 10T$ (source: (ECO, 2016)).

New growth

– by shortening supply chain complexity length

- by favoring the circular economy

- via a taxation system

- that promotes circular design of products

- by public promotion measures

- through public education

- at school

- fostering public awareness

– technical and technological

- through the transformative power of AI (power + impact solutions)

- quantum computing, blockchain, the Internet of Things (IoT), big data, cloud services

- smart cities, human augmentation

- 3D and 4D printing

- smart nanomaterials, synthetic biology

- through the rethinking of models

- business models, accountancy standards

- risk assessment approaches, financial reporting practices, legal and regulatory frameworks

- supporting governance systems

– by fostering new principles and business models

- Product as a Service

- ecodesign

- Pay per Performance

- with an IT platform

- open, distributed

- blockchained

- by reducing bottlenecks

- difficulty of product disassembly

- through product design

- ecodesign

- by reversing logistics

- through infrastructure

– solidarity

- trust

- turning trust into reduction for adherents (the SCEC in Italy is an unconditional discount system)

- confidence: blockchain

- collaborative spirit (aversion is individualism)

- win-win

– local economy

- Km0 agriculture

– craft

– unites – cohesion

- among players

- sets a 3G triangular process: give (offer, have) – get (receives) – gear (grant, contribute, yield, cause, give out, pass around, deal, turn over, make over, vouchsafe) – the gear is fundamental!

- associates producer and consumer: the prosumer

– provides support for services

– reinvestment

- local only

- Time Banks (selling Time as a service)

- of profits after costs to suppliers (added-value retrocession)

– a new entrepreneurship culture

- underpinned by cohesion and collaboration

– the support is inside

- everybody acts as a third party acting for trust: distributed yet visible trust

– by reinventing existing sectors

- media,
- healthcare,
- education,
- transport,
- retail,
- construction,
- financial services

And why not attempt sketching a growth inspired by Nature?

Bio-inspired growth

– by mimicking Nature's material and energy flows

– by mimicking circularity on Nature

- for production
  - ecodesign
  - industrial ecology
- for consumption
- for sustainability
- through behavior
  - responsible consumption
- through waste valorization
  - by recycling

– through functional economy

- by use of less product ownership

- by product usage only (and not ownership at all)

- by fostering new principles and business models.

A number of projects are currently active that depart from traditional growth views. The European FoTRRIS Nr. 665906 project (http://fotrris-h2020.eu) aims at "fostering a transition towards responsible research and innovation systems." In [SNI 15], Anne Snick typically imposes, using only renewable resources as a necessary economic function, a step which supports the regenerating of a new economic space:

> "… Therefore emergent alternatives invest in a new kind of public space where resources are allocated to the common good while involving citizens as 'prosumers', producing as well as consuming the services they co-create. This space for economic regrowth is called 'the commons'."

7.6. Charting GDP's dominant designs and breaking axes

This section is pictured through six boxes that synthesize the findings of 16 dominant designs along with a number of breaking axes. We introduce part of a method in three points:

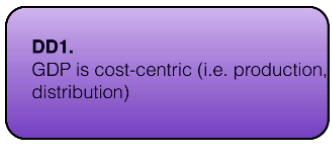
– We distinguish two fundamental representation spaces, namely the knowledge space (K) and the concepts space (C). Think of them as two representation areas where we plot the knowledge domains within the K space and the concepts to elaborate in the C space.

– The K space is first populated with the knowledge that we have about growth. This already exists as a domain of expertise and will not be covered in this book. For the time being, we will populate the K space with an understanding of a number of dominant designs about the notion of growth.

– The C space will receive the expansions to be made from the blueprints at hand (e.g. the "blueprint concept zero" seen in Chapter 2), which we will perform in later chapters.

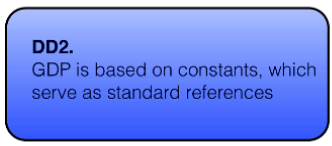
Appendix 1 is a reference primer on the background of C-K theory that we are using here. This is a leading design innovation theory based on advanced mathematics developed by the *Centre de Gestion Scientifique* of Mines ParisTech which has been in intensive use in the innovation business in industry and administration since the mid-1990s (HAT 03)[2]. The reader may first skip the Appendix and simply follow the design path implemented in this book. To deepen the investigation on growth, we recommend either studying the theory and the associated methodology or setting dedicated field workshops on growth and its derived notions in order to learn the process. Concrete results are obtained that yield high originality and variety, plus an estimation of their robustness and value. For further inquiries, please also refer to the dedicated references.

The dominant designs about growth are pictured in the following six charts.



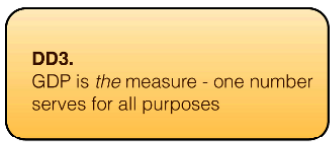
Explanation: Pricing of things is based on accumulated costs to produce them - GDP does not value the improvement if not via the new costs (Cf. Adam Smith « the full cost pricing »)

Breaking axis 1: An innovation-centric economy (Moore's Law is reference standard underpinning it) - value the improvement (e.g. the «Gear», cf. the 3G model introduced earlier)



Explanation: (Like the speed of light in relativity theory) Economic measurements reflect a same constant story independently of context - although there is a divergence over time

Breaking axis 2: There can be a million different economies (and prices too) - overcome DD2 beyond dynamic fixation of prices



Explanation: GDP is the value-added in an economy (adjusted for inflation) - but this hides the evolution (which is an entropy): it remains a static view.
«Add up the value of what is produced, net of inputs, across a wide variety of business lines, weighting each according to its importance in the economy» (TNE, 16)
GDP risks serving all its purposes ever-less well. As things get altered in every domain, it should be no more a stable domain

Breaking axis 3: Introduce indicators accounting for evolution, not stocks and other fixed assets

2 The effectiveness of using C-K design theory has been proven in many business and industrial contexts. For the readers interested in learning about it in an easy and highly illustrated way, we may recommend reading introductory papers or using the specifically designed interactive and illustrated eBook series (see bibliography).

DD1.
Is focused on the cost of activities

Explanation: Like a stock - adding or subtracting to real wealth - does not calculate destruction (destructed value) - transaction costs are the single biggest brake for flows: by reducing then to close to zero triggers flows, hence economy - assets or estate? repairs? damages? rebuilds? - loss of wealth - unprofitability - underdevelopment (degrowth - Inefficiencies in flows create financial burden, marginalizes people) (TNE, 16)

Breaking axis 1: Technology can help and is ready: blockchains for assets exchanges - what is a suitable framework for Growth?

DD2.
Volume growth is only healthy indicator

Explanation: This is equivalent to ignore the structure of a network - Development is measured as levels of GDP/capital it become impossible to differentiate between a healthy (resilient, prosperous) economy and a bubble - Or between a healthy development and an explosive growth of monetary exchanges due to speculation

Breaking axis 2: Ensure the detection of a healthy or not growth based on productivity
Instead of GDP, use GSV (VSB) Gross Service Value, create goods service at little/no cost
What can be another (type of) growth?

DD3.
Is triggered from monetizing things

Explanation: (Creating flows) Question is then how to create flow? Often, it is created by creating debt (therefore money flows)

Breaking axis 3: What can be another (type of) growth? how to stimulate wealth in the contemporary context

DD4.
GDP statistics are (past) snapshots only

Explanation: Are subject to (permanent!) revisions, a paradox - they track a position in time, yet a past position anyway

Breaking axis 4: Track capacities (a bit similar to the way EC's FP7 R&D Programme targeted «capacities» building since the early 2000's

DD5.
Accounting-wide, most of an innovation path and process is an orphan happening

Explanation: Innovation is not found in the balance sheet, a big societal miss. Since innovation is growing (everywhere), more is missed each day (ex. Airbnb statistics vs hotels!; private cars can be Uber taxis; a free software upgrade renews an aging computer; social networks-based entertainment at no price for everybody - from (TNE, 16))

Breaking axis 5: Introduce indicators for change, both deep (radical) and superficial change

DD6.
What is valuable is the tangible and the tradable

Explanation: Simply not true: *« Kennedy was right: much of what is valuable is neither tangible nor tradable»* - *« Much of what is tradable is also not tangible»* (TNE, 16)

Breaking axis 6: Introduce further perception indicators which make appreciate the value of the intangible

DD7.
GDP retains manufacturing bias: is a manufacturing-dominated measure

Explanation: Manufacturing was ⅓ of British economy in the 1950's and today has grown up to one tenth - but services are less well measured - manufacturing output is broken down into 24 separate industries but services are subdivided into twice as many only - yet they account for 80% of the economy) (from (TNE, 16)

Breaking axis 7: Proportionate services nomenclature to traditional domains of economy (principle : divide (classes) to multiply (value))

DD8.
GDP is offer/demand-conventional: measures only output that is bought and sold

Explanation: Is so because market transactions are taxable (therefore of interest to the state who makes the statistics)

Breaking axis 8: Have state decentralized and play network models, where each node has equal play value under global rules

DD9.
GDP statistics are influenced by policies

Explanation: Policies are set to manage aggregated demand

Breaking axis 9: keep harmonization policies yet relax policies which may discourage growth (e.g. taxation rules, human employment, etc.)

DD10.
GDP is bound to market prices (i.e. puts a value on the output, aims at the price)

Explanation: Excludes « home production »: household, caring for others (which has high value). Inflation is making the thing tricky, price elasticity as a response to demand as well, also the weight attached to each category of goods - « If you focus on changes in prices, you overstate the true inflation rate by missing improvements in performance» (TNE, 16) = no adjustment for quality and new products (this calls for «hedonic» estimation)!

Breaking axis 10: Reposition GDP asset base (a lot of what is included in GDP lies outside the market economy: e.g. free gov services, etc.)

DD11.
Services are measured obliquely

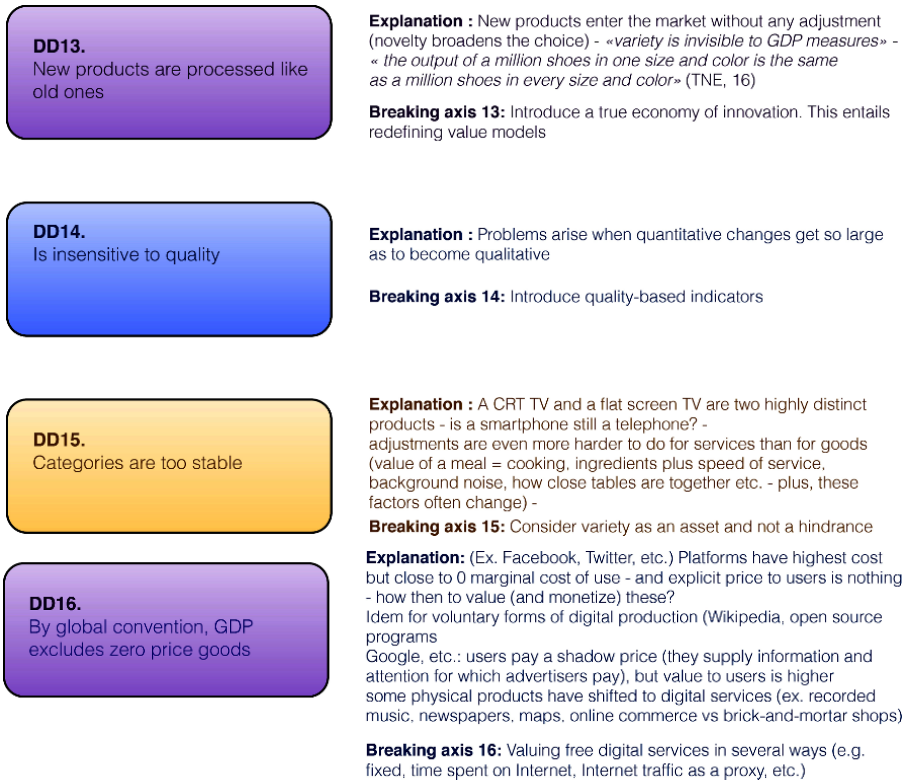
Explanation: Services are often not paid for directly

Breaking axis 11: Introduce contributive value of services by making them more tangible (e.g. through new indicators and standards)

DD12.
GDP standards upgrades are set by adding new activities

Explanation: Illicit activities can then increase GDP measure!

Breaking axis 12: introduce arithmetic in GDP measure :+ and - contributive indicators, even weighted, harmonize



When analyzing the dominant designs above, a surprise rises to our attention: why did such an economic concept resist the successive industrial revolutions (from industry's initial development to the Internet, the data revolution leading to the advent of the Data Scientist as the main director of an orchestra of plenty of connected "objects", i.e. physical and moral persons, material objects, etc.)? Time is up to unlock the long set brakes on an old economic indicator. Time is up to flex it, to widen it, to enrich it.

Having obtained a number of dominant designs, we show how to proceed in opening up new potential (conceptual) areas for growth by breaking the former. We show only a few examples, as this work is best done within systematic and collaborative workshops. Indeed, the number of resulting concepts can be large. We thus begin work in relation to the C space.

7.7. Blueprinting new growth concepts

We advocate the exposure to thinking in the unknown. This is intended to counter the patterns of dominant thoughts, the way of doing things that has been sedimented in the habitual minds of practitioners and decision makers. In the same way as Forrester presented an "exposure to cause and effect thinking and computer modeling", we present a capacity to resign in the unknown.

Breaking dominant designs entails finding a rupture axis able to generate fresh directions of investigation. Here are a few example blueprints for later conceptual expansion and project feasibility investigation:

– C1: a smart GDP measure that can track changes:

- as a bundle of "constructive measures";

- accounting for the vast changes in the quality and range of goods and services that we consume.

C1 enhances innovation-based economies, i.e. change, before still assets.

– C2: a smart GDP measure that finds ways to compare:

C2 takes account of, for example, hand-held email with a fax machine, a self-driving car with a jalopy, vinyl records with music streaming services, custom-made prostheses with health-device crutches, etc. [THE 16]. The C2 blueprint concept formulates a continuity-driven wealth measure across epochs of human development.

– C3: a smart GDP measure that measures wealth ethically:

C3 is revolutionary because ethics is rarely taken as a subject in itself. In a complex society, based on all but systemic effects, it should deserve top priority instead. Environmental ethics have been considered since the 1970s: Nature, for its biodiversity, and the impending moral obligations for humans. Much more than morale, ethics is of key importance to reconstruct a balanced and respectful man–environment relationship. But how to measure our level of ethics and consciousness until a proper definition for GDP is accepted? There exists an environmental code of practice (i.e. an Earth charter that is a basis for environmental/sustainability policies) that can induce behavioral changes for a truly sustainable society.

– C4: a smart GDP measure that transcends production and demand:

C4 is a concept that engages valuing the perception of goods throughout a value chain.

– C5: a smart GDP measure that values zero-priced goods:

C5 opens up the entire chunk of voluntary-based services.

We have provided above a first list of radical conceptual expressions to work from, each pointing towards a breaking direction. For this reason, these are often called “projectors”, “projective concepts” or “searchlight concepts”. They actually are implementable blueprints for unfolding the design-based approach.

This section resorts to forging innovative promising concepts, ready for investigation, yet underdeveloped in this version of the book. The acceptable solutions will derive from an expansion process acting from these new blueprints. In the end, the solutions should be documented as to provide the definitional arguments and characteristics of innovative projects that can then be implemented. Such projects can be developed with minimum risk, as their definition was scoped with the necessary and sufficient features to implement, thanks to the methodology followed.

More generally, it is advisable, when performing dedicated field workshops, to formulate growth concepts with such desirable properties as:

– “green” growth;

– distributed growth;

– growth harmonious for the people;

– economic growth that yields meaning for humans;

– quantitatively infinite economic growth (which never ceases to increase in quantity);

– qualitatively infinite economic growth (which never ceases to increase in quality);

– growth without by consequences for the planet;

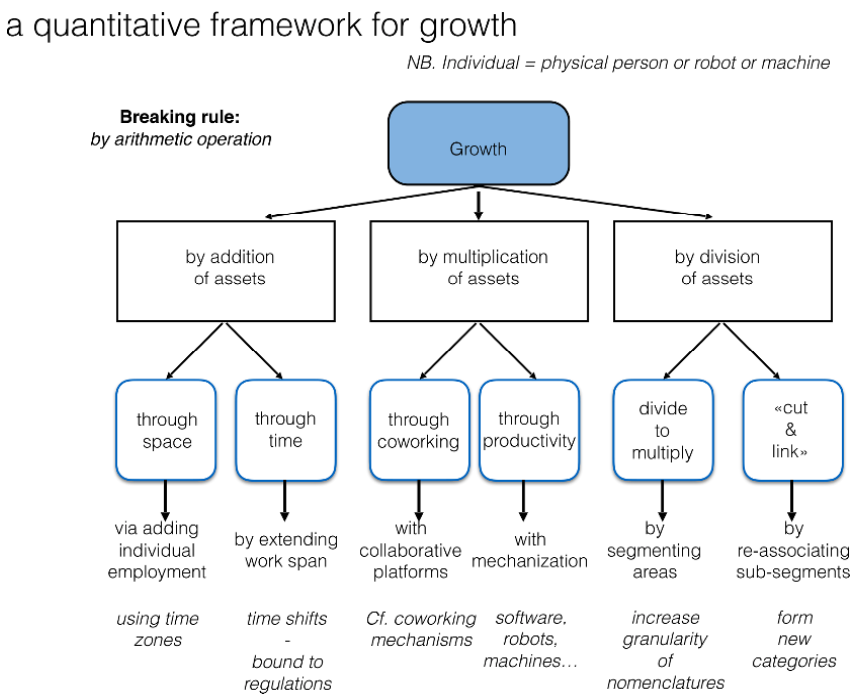
– economic growth which…

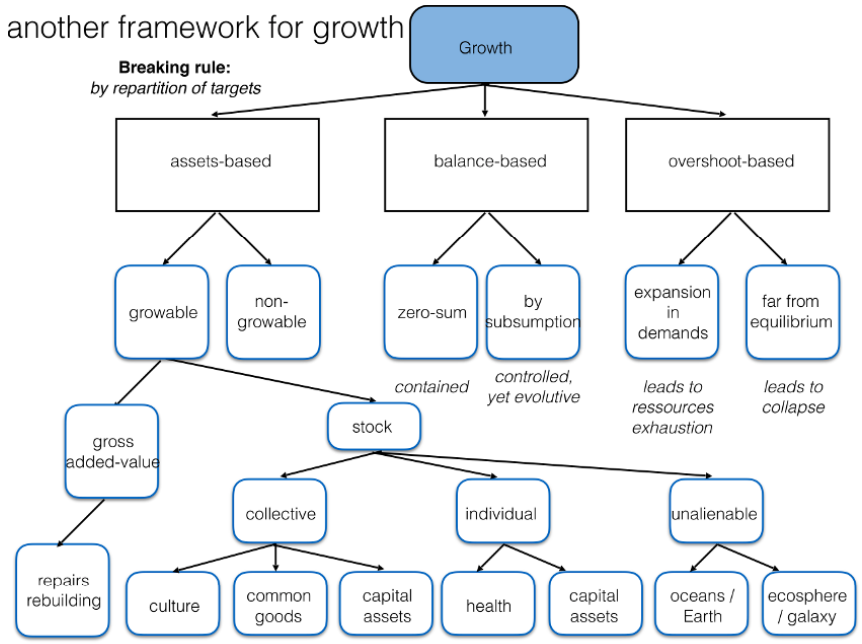
(the reader will formulate more such concepts)

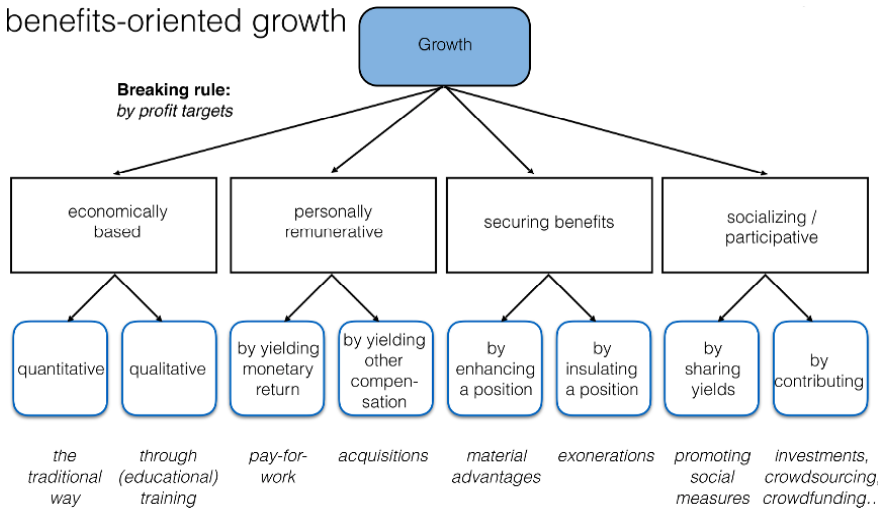
The way these blueprint concepts are expressed serves the purpose of opening up investigating territories that weren't walked before due to prevalent dominant designs. As crazy as they may be perceived, formulating them with such a sense of undecidability is key to the successful outcome of the process. By success, we here mean the specific capacity to obtain *a priori* feasible propositions that can define future implementation or research projects, be they short- or longer-term for an organization, a company, a state, etc.

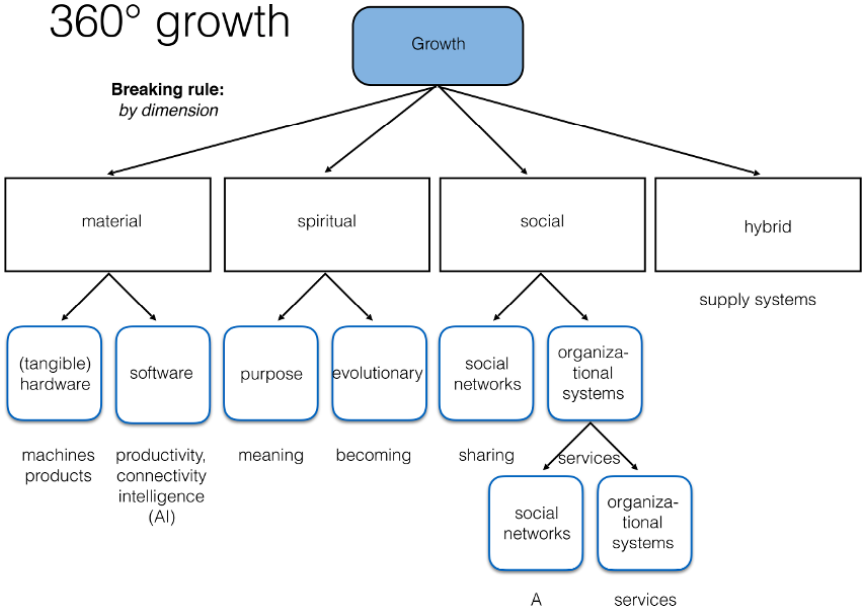
7.8. Expanding on growth-related concepts

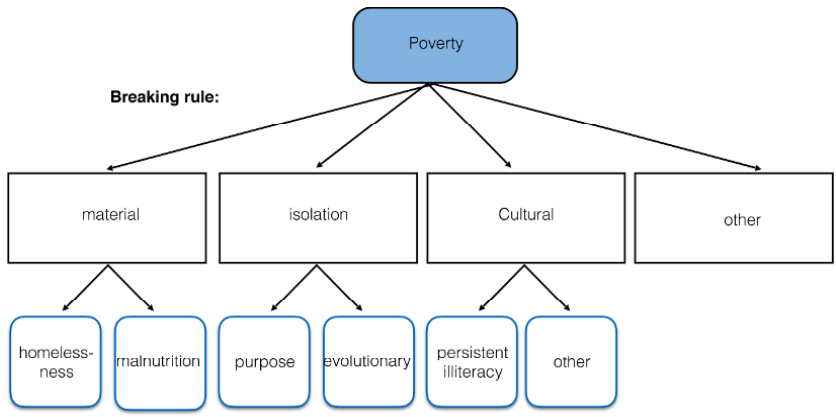
The following charts exemplify a number of expansions. Many more can be formulated through dedicated workshops targeting issues and problematics related to growth.




another framework for growth
Growth
Breaking rule:
by repartition of targets
assets-based
balance-based
overshoot-based
growable
non-growable
zero-sum
by subsumption
expansion in demands
far from equilibrium
contained
controlled, yet evolutive
leads to ressources exhaustion
leads to collapse
gross added-value
stock
collective
individual
unalienable
repairs rebuilding
culture
common goods
capital assets
health
capital assets
oceans / Earth
ecosphere / galaxy


benefits-oriented growth
Growth
Breaking rule:
by profit targets
economically based
personally remunerative
securing benefits
socializing / participative
quantitative
qualitative
by yielding monetary return
by yielding other compen-sation
by enhancing a position
by insulating a position
by sharing yields
by contributing
the traditional way
through (educational) training
pay-for-work
acquisitions
material advantages
exonerations
promoting social measures
investments, crowdsourcing, crowdfunding…


360° growth
Growth
Breaking rule:
by dimension
material
spiritual
social
hybrid
supply systems
(tangible) hardware
software
purpose
evolutionary
social networks
organiza-tional systems
machines products
productivity, connectivity intelligence (AI)
meaning
becoming
sharing
services
social networks
organiza-tional systems
A
services


Poverty
Breaking rule:
material
isolation
Cultural
other
homeless-ness
malnutrition
purpose
evolutionary
persistent illiteracy
other

8

Opening Up New Growth Axes

> "… Findings indicate that the economic growth approach, widely studied using GDP, has been wrongly interpreted by policy makers trying to achieve increased sustainable development."
>
> SANTOS GASPAR J. *et al*. [SAN 16]

8.1. Energy is everything; efficiency best manages it

The previous chapter showed the high degree of fixation reflected by the notion of GDP. Should we even speak of a degree of "fossilization"? After all, GDP was born out of a completely material world which reflected the first industrial epoch. Growth can be understood as an outer asset such as stock, balance, even demographic explosion, etc., quantitatively or qualitatively. And of course, always dependent on energy availability.

Now think! Since then, electricity was discovered, and electrical sources, production devices, distribution means, even storage capacities, all were invented. Then electronics, then telecommunications, then informatics, then computerized networks, then object connectivity, then uberization, then the growing "datafication" of society (with data mining, big data, cognitive robotics, etc.).

How can GDP resist a day more? We should have "electrified" GDP by now, but we haven't understood the message the electricity fairy was

Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter, First Edition. Patrick Corsi.

telling us: that the world was fluid, connected before anything! In the beginning, you couldn't *store* a quantity of electricity. Since then, we should have learned to represent a rebirth GDP in the embodiment of a movement, a flux, a connecting thing. The drift was set from an ancestral measure, and the damage offered to humanity can only grow.

The analysis leads to considering the concept of (energy) efficiency applied to growth. The Green Paper on Energy Efficiency (EE) of the European Commission [ICT 06] intuitively defined EE as the energy way to "do more with less". EE performance can be defined as the energy intensity EI over a primary GNP:

$$EE = EI / GDP$$

Why then should a primary GDP grow first? It's best to ensure the ratio instead of that nominal value. Then, energy intensity (the "quantity of energy") is the ratio of energy consumption to GDP, which is a measure of the quantity of energy necessary to produce one GDP unit:

$$EE = EI / GDP = EC / GDP^2$$

The evolution of energy intensity reveals an economy's capacity to create wealth through energy. As a reminder, the top 10 industrial sectors in energy intensity terms are aluminum, concrete, ceramics, chemicals, agro-food, glass, steel industry, foundries, non-iron metals and pulp and paper. Most of these sectors are highly capital-intensive too [ICT 06]. EE is a measure that tracks the efficacy of employing and using energy. As an example, let's sketch a few simple ways of increasing EE:

– Increasing energy efficiency:
  - by reducing use of pesticides
  - by increasing renewables
  - by becoming sustainable:
    - in agro-food:
      - permaculture
      - urban gardening
      - aquaponic

8.2. Option one: “electrifying GDP”

Applied to GDP, we now see how virtuous an “electricity-like GDP” notion can be to the services economy. At the light of this discussion, we are encouraged to think the breaking of some of the dominant designs of the previous chapter in an “electric way”. More specifically, if we recapitulate a small subset of the dominant designs, say this one:

– DD1 – GDP is cost-centric (i.e. production, distribution).

– DD2 – GDP is based on constants, which serve as standard references.

– DD4 – GDP is focused on the cost *of activities*.

– DD6 – What is valuable is the tangible and the tradable.

– DD7 – GDP retains manufacturing bias: is a manufacturing-dominated measure.

And recollecting the breaking points that we just wrote in the previous chapter (which aren’t exhaustive either!), we then can’t resist defining a new GDP-like concept like energy! For instance, in this form:

– CE1 – “Electric” GDP: a GDP-E1 measure that embeds some of the properties of electricity:

- zero-marginal cost;

- pricing varies depending on the usage of products; and

- no storage: storing goods and not using them is penalized.

Developing the CE1 concept would require an entire workshop, but it would be worth to grow entire new economies as “energy grids”. This would be adapted to specific or coherent geographic zones, which can be rather large as well.

Or perhaps this one too:

– CE2 – Service Preference: a GDP-E2 measure that excludes anything that is not a finished (and perhaps, service) good. With one or the other following properties:

- where manufacturing is paid for by usage;

- where new policies discourage tangible goods from measure; and
- where new growth indicators are based on prices.

As crazy as they sound at first, there is much room for expanding them. New unsought value chains can be forged: the stepwise dividing of cascade intermediary producers of goods (e.g. an electricity producer, then a storage transporter, then a local transformer, then a machine tool producer, then a product or an appliance producer, then a service provider) tends to slow down the global value yield. If instead of a linear progression, there were plenty of feedback loops, each granting a value to stakeholders, the resulting friction would be considerably less, plus the need for securing a viable return profit at each intermediary steps would be much alleviated.

In summary, the widest solution to the growth conundrum seems to reside in systemic operations. Which requires a minimum degree of cooperative models, hence the impact on straight competition and the isolationist behaviors it tends to provoke. It is no surprise that we develop altered models of competitive behaviors in this book (like coopetition and comperation): they become indispensable.

These are only examples, as it is not possible in a small volume to expand the reasoning for all dominant designs and possible breaking axes. Our aim is mainly to show that a way is made possible, and that we have both the concepts and the methodology should we want to follow suit in these directions.

8.3. Option two: “efficiency GDP”

How much energy do I need? How much do I use for that particular task? Could I use less energy for the same task? Is there a better (mix of) energy(ies) to use for the same task? Could I save energy otherwise wasted? (Still assuming such behaviors leads to societal progress: efficiency and comfort.)

These questions lead to considering the notion of “employment per need”, this time a global efficiency notion that attempts at accounting for *the ways* we develop and use “energy-like GDP”. Unfortunately, micro-economic theories do not yet seem to provide us with many compact and global efficiency concepts such as “energy employment rate” or “best energy

at given time", etc. Training and shared good usage practices become highly important in our present-day society, and learning new behaviors is paramount. Instead of thinking about new taxes (or the now obsolete polluter–payer schemes), it is useful to encourage virtuous behaviors: these will gradually resolve macro problems such as pollution, expenditures, waste, etc.

We have here an instance of the gear lever that may be actioned between a micro level (an individual behavior) and a macro yield (a country, society, even the planet). The 3G model we introduced in Chapter 6, because it is intrinsically generic, embeds the power of connecting and gearing levels up:

Micro level → Meso level

Meso level → Macro level

As we wrote in the "ICT for Environment and Sustainability – ICT for Eco/EE 23 March 2006 Workshop Report" as rapporteur, "*the Eco-Energy efficiency issue is a multi-scale, multi-dimensional problem governance issue. For instance, considering the overall early maturity*[1] *level of Energy Efficiency […] and observing the high level of fragmentation in its offerings, there exists an untapped yet expectable impact for policy making, governance and arbitrages.*"

Viewing growth as a quantity leads to framing it arithmetically, but viewing it qualitatively leads to framing it with a target-oriented conceptual expansion. Viewing growth qualitatively leads to expanding growth via who is the beneficiary. At this time, it can already be sensed that inner growth *is* also a type of growth – thus leading to entire realms of possibilities, albeit even less material indeed and which measures may call yet other indicators!

8.4. A side note

Would such an open-in-all-directions growth understanding lead to a partial demonetization of the commercial world? This may perhaps be possible. As can be seen today with the striving forms of economies such as

1 In 2006.

cradle-to-cradle, circular, ecological, a lot of cooperative modes aggregate that aren't always accounted in monetary form.

The expansions discussed in this chapter already provide formulas for the dimensional augmentation of growth. Which leads us to delineate an augmentative formulation for the economy. In Chapter 6, the eight-shaped figures (e.g. Figure 6.3) depicting unlimited combinations of the ternary model clearly show the engagement way up that does nothing but augments the value of a specific transaction (i.e. any creation, actually any activity bearing some value). It is a perpetual motion engaging value augmentation that isn't – for its most and growing part – based on finite or material assets. Then, could a new GDP-like measure follow suit? Or more? This represents a way to break free from the dualistic view of the same transactions and creations.

8.5. On distribution and its criteria

When visualizing the expansionist movement created from the unlimited gearing process, it becomes plain that the main societal issue becomes the distribution of value. It wouldn't be much relevant to target equal distribution of goods and values for everybody, because not everybody needs or even wants the same amount of resources, products, material assets, vacation time, etc. The four traditional levels of marketing that draw a distinction between levels of needs are:

Necessities << Needs << Desires << Preferences

For instance, a personal preference supersedes the contemplation and choice of a specific answer to a given need; e.g. my preference for fiber cereals supersedes the need for having wheat food at breakfast. Therefore, fair distribution isn't even a goal to wish globally. It is therefore highly important that we set paradigms that reflect the differences and the human variety. It is the approach that counts and resolves an otherwise absurd principle. The approach to material things – oh, with the right distancing from it however… because even material object is a concept when using it:

it's energy in our minds! Therefore, our attitudes can transform economy (individual to global), and here we have a fantastic reversal of a well-entrenched motto; not this:

Think globally, Act locally

but this:

Think locally, Act globally

Fair distribution is that ample movement that enables any corner of the world to be irrigated by the same flows. The classical way to infuse (investments) locally and expect global results isn't proven: there are too many blocks on the road for an amplification process to proceed by itself. By rebalancing the pivotal points in the 3G model, we unlock the deadlocks, i.e. all these stagnant economic situations that are as many dying zones, from which nobody even profits.

PART 3

Going Beyond the Notion of GDP

9

New Growth Operational Formulations with Examples

"What is growth if not to help ordinary people thrive?"

Winnie BYANYIMA,
Executive Director Oxfam International

9.1. A quick return to system dynamics

From the above analysis, a number of actions can be taken up immediately. First, organizing a series of design workshops implementing similar design-based approaches, each on specific economic growth thematics, would help disseminate the "mind range" factor which is necessary to draw up field solutions at different scales in society. The relevant knowledge and the minimum resources for implementing them already exist, and study groups can be deployed.

These can set a positive dynamics, yet the real issue is the differentiation of dynamics between the nominal evolution of the surrounding system and those of the corrective actions that we set. It is the difference (of speed) between the each derivative which will determine the outcome of any global evolution. For this reason, it is necessary to launch actions with accelerated returns, at least one order of derivative superior to the nominal dynamic of the overall system.

Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter, First Edition. Patrick Corsi.

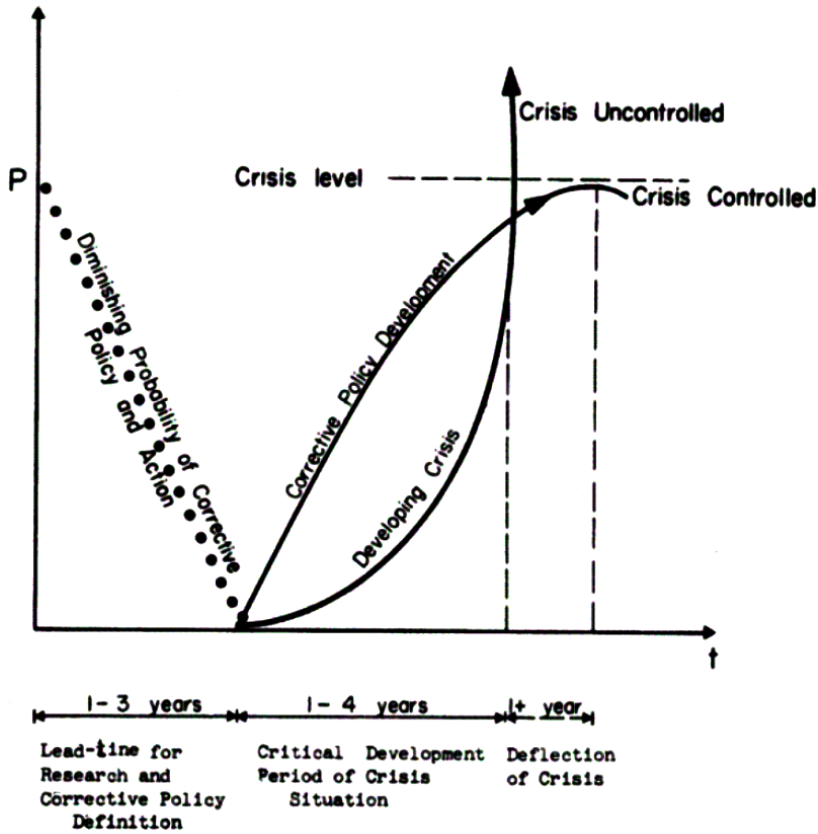


Figure 9.1. *The mechanics for deflecting critical events in time (from Prof. Platt [THE 70])*

In [THE 70], we see an interesting diagram (see Figure 9.1), spun off from the system dynamics discipline, which is exposing the rapports between these dynamics and what it entails to alter the damaging curse of an evolution. This paper adds an enlightening comment:

> "*Critical events behave approximately as shown above. Namely, there is a crisis level at about 4 years hence beyond which most of the events we must consider will become uncontrollable, unless they have been deflected by newly developed corrective policies*."

> "*The deflection period must be conceived as short to be effective (l+year). The lead-time for projects such as the present is generally set to 1–3 years. These […] represent an averaged-out consensus of those working in Crisis Research in the USA. They were obtained from Dr. John Platt of the University of Michigan at Ann Arbor*".

We cannot tell to what extent the periods indicated apply in today's context. Most probably, many feedback loops are activated and interfere among each other and render a resulting situation much more complex, which actually would mean a condition far more difficult to control and even monitor.

9.2. How to balance the disequilibria by injecting a conduct way

It may be that the condition monitoring to restore the lack of balance in economic systems requires an "inner condition". In other words, it is that consciousness that is capable of sensing the reasonable limits beyond which the system diverges. By "inner", we want to mean "integrative of operations", a sort of built-in safe conduct.

Our business world is content to consider products services and processes as economic targets. For the sake of simplification, we would say that e.g. business models are processes. To our opinion, it lacks a fourth component, that "inner component" able to do the condition monitoring. Our business world resembles a scene made of automobiles (firms) and transported objects (products, services, processes). The regulation exists: it is the infrastructure with the rules of the road. But is this enough? We also need capable, competent drivers, who will operate safely, respecting not only the Highway Code but also other drivers and the environment too. Still, as we note that a prescriptive road traffic regulation system is coercive, there is nothing that prevents deviating from them in any way. It would take fully autonomous vehicles to finally get to that maturity stage (and this trend is here).

In other words, what is lacking is an operations conduct. This is different from regulations, takes these in anyway, yet dynamically adjusts to impending conditions and still maintains a global safe operational context.

Again, only a systemic approach can tackle the issue. Synonyms for this "operations conduct" concept are:

> *Governance – Attitude – Belonging – Behavior – Way – Method – Practice – Recipe – Style…*

Some automobile insurances deliver certificates of good conduct, thus signaling the same idea behind. Antonyms would be:

> *Convention – Regime – Artifact – Solution – Procedure – Formula…*

Specifying a conduct without ambiguity can be done through jurisprudence, not prescriptiveness. And there are an infinity of conducts, perhaps all admissible.

After all, a product or a service is "condensed conduct". While a conduct is mobilization, both in terms of knowledge and skills, and in experience. This can be summarized by saying "*a conduct de-condenses*". A product in use is a mixture product + the way the user uses it, which is a different tool with varied functions. A service in use gets a different pattern, a new direction. A process changes mode, a different method. A conduct is a (energy) way to transfer experience.

Examples of conducts are: a fielded strategy, a tactic management, a meeting, and all usage situations (a usage generates an eventful ecosystem), i.e. when we put our hands onto something. Conduct results are experience returns, know-how and another (improved) conduct, perhaps a sustained conduct.

Counter-examples abound: a self-service urban electric vehicle while there is limited product availability, low invitation to its usage and the weight of the possession dominant design relative to city automobiles.

What triggers a conduct (and hence a growth) is: the mass availability of a good + service package (think of iTunes when launched: it revolutionized music listening usage thanks to the couple "massively available iPod" plus the free of charge iTunes platform without access barrier). There is an augmentative effect when deploying content (here, music). Again, it is the

electric energy paradigm at play. Myriads of segments appear: here, new music categories, an "art and science" of regenerating the concept of playlists (my playlist, a playlist that evolves with my tastes, etc.). If we were to use a known physics analogy, we would say: the mass is the iPod, the energy is iTunes and the light is music.

Specifying a conduct is not by prescription: users know best! Give the right tools to people and they will invent the story that goes along with it. Non-denumerable ways are potentially possible. A fixation is that, as a supplier we tend to view and judge the many and often strange ways people use a given product. While they instead grow conducts: there is intrinsic growth! Besides a few harmony, fairness and other ethic rules, we may want to define codes of conducts that do not hamper the creative capacity of future users for the reason this roots growth! Lessons for growth are contained in the conduct model, which happily complement the traditional economic triad product-service-process. Dedicated workshops on conducts in every domain sector would be available to regenerate growth inside them. For instance, a transportation industry would redefine itself as a mobility economy or a service-centric utility. These are not mince intellectual changes, they are entire revolutions of entire industrial domains at work. There is an ability to generate portfolios of conducts, translated into myriads of services and packages, with a bonus: an intrinsic capacity to sustain the activity. Figure 9.2 recapitulates the four economic modalities and the next sketch exemplifies the key transition from a product modality to a service one.

Shifting from a product-centric to a service-centric view

– product-centric: possession, capitalization, product cycle

- selling a product closes a movement. A product that is sold does not produce market value anymore

- but its usage begins, continues and can go on theoretically indefinitely. This is a paradox of the economy based on products. This economy is limited and reaches a maximum

- example: carpooling, not owning a car

– service-centric

- a product produces usage, data, etc. This can be monetized

9.3. Why isn't a circular economy enough?

The "circular economy" is an industrial system that is restorative by intention and design: it fosters reuse, materials recycling and resource efficiency. Its benefits over the traditional economic way have been largely documented so far[1]. The view clearly underpins a shift from a linear philosophy of economy ("take, make & dispose") where the resource flow is linear. But it is not enough to be circular, there is a little flaw in the concept that makes a big difference and it is that:

> *Being efficient (in reusing and recycling) does not imply a development*

4 ECONOMIC STATES	Product	Service	Process	Conduct
Economic model	B2B - B2C	B2B - B2C	B2B	B 2 Teams
Access	Interface	Adaptation	Depth	Behavior
Depth	Surface	Adoption	Consciousness	Sharing
Optimisation	Robustness	Variety	Originality	Martingale

Figure 9.2. *Four modes of economy goods*

Herein, the "doing more with less" (a short-cut definition of efficiency) is not a generative property. To free growth, we need generativity. This property was in appearance achieved over the last two to three centuries by the dominance disposal philosophy – a mere palliative compensating for the lack of a better model by simply substituting an older product (even is usable) by a new one. The replacement attitude does create a "market vacuum" that is happily filled by a new offer. This nuance does not seem to be always documented in the literature nor it is always relayed by the political or media forces at the moment. Reason may be that generativity is a somewhat more difficult mental concept for easy communication.

1 See http://www.clubofrome.org/a-new-club-of-rome-study-on-the-circular-economy-and-benefits-for-society/ *or* http://ec.europa.eu/environment/circular-economy/

By consequence, the growth virtue brought about by the circular economy seems limited to additional work along longer product lifecycles [THE 70]:

> "*The main reason, of course, is that caring for what has already been produced – through repair, maintenance, upgrading and remanufacturing – is more labour intensive than both mining and manufacturing (often in highly automated and robotized facilities)*".

Yet, with the advent of smart algorithms, robots and other machines, the argument becomes weaker and weaker as the gain in labor force becomes economically less and less viable respectively to intelligent artificial means (gaining in productivity and cost/delay/quality benefits). It is far from evident that such additionally gained human expertise in labor still compares favorably for long to the ever rising capacities of artificial means. Unless sharp enough taxation measures on VAT and other (taxation or not) lines are injected in the economy, which is not the most probable option.

The following sketch proposes a working sheet for actuating a tentative, partial at best, decoupling of growth from the use of resources:

Decoupling economic growth from resource use

– inclusive and circular economy

– decoupling energy and resources use from growth

  - from undesired environmental impacts

  - soil fertility

  - biodiversity

  - not diminish resources stocks

  - not lead to increased toxicity of land, water, air

– enhancing resource efficiency

– enhancing social benefits

– breaking any monopole

  - into small entities

- into smallest interacting entities: smaller units of everything

- increases the connectivity factor

- divide to multiply: byte-size multiplies

- by aggregative faculty: scales up

- Metcalfe's Law: the value of a network squares the number of its nodes

- Translation: the wealth is maximal when the graph is complete (all nodes connected), this is the maximum level for building growth. In a centralized mode, the level is instead minimal (one point only, a mandatory passage)

- by sharing an open structure

- comment: as companies grow bigger and bigger, the customers tend to become unsatisfied (they lose control, are far from the source, some are excluded, others grow incomprehension). Big companies tend to capture most of the economic value in a centralized way. What if a decentralized model would prevail? This may open up growth incommensurably

– breaking the necessity of intermediaries

- by suppressing them

- by bypassing them

- by uberizing them (making them obsolete)

– enhancing security of transactions

- via a third party

- via blockchains

– enhancing user autonomy

- through an auto-carrier independent system

Furthermore, the concept of efficiency (energy or any resource wise) is not a well-circumscribed, homogeneous concept. We need to go spiral, with open-ended loops that trigger new virtuous "circular economies", involving respect for nature and fair distribution. Without such concept, models are rather useless and everything stays the same, even probably will accelerate in the next future.

10

Discussing Work, Labor and Money

> "Economic growth without social progress lets the great majority of the people remain in poverty, while a privileged few reap the benefits of rising abundance."
>
> John F. KENNEDY

10.1. Is work still on demand?

Capital is composed of money, talent and skills, knowledge, information and data. While the European Commission report [EUR 16] still views work as a transfer from talent to economic value, it also recognizes its bringing out of *meaning*. Yet, the volatility of economic forces and recovery intensifies an emphasis on shorter-term happenings, where people meet people more openly, i.e. the onset of circular economy.

But it is automation that takes precedence instead, the main cost of any business being labor. Work automation has been a hot subject topic since 2016[1], the year when a factory in China replaced 90% of its workers with robots. Artificial voices operated by AI algorithms replace human agents in call centers and customer services. The uberization of the economy promises to replace human agents (e.g. taxi drivers) by self-driving cars, etc. and the list will not stop here.

1 http://www.techrepublic.com/article/is-data-labeling-the-new-blue-collar-job-of-the-ai-era/.

Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter, First Edition. Patrick Corsi.

And then, the non-human work performed by machines, also known as robots, and the army of algorithms, today not only are content to execute, but also can learn from new situations and rather soon will be able to design.

The European Political Strategy Centre (EPSC) – the European Commission's in-house think tank – outlines a Work 4.0 transformation where jobs are broken down into projects of varied borders. Actually, work is becoming a world of relations with multiple views: people and machines, skills and competencies, geo zones and organizations of all kinds. The value chains have become relational systems. Work is plunged in the openness paradigm and *working* has become the capacity to articulate the region with own features with the environmental ones. The world of work is becoming "atomic" (aggregates broken down into pieces) and at the same time it is globalized as a single giant planetary pool of expertise and know-how.

Long gone is the corporate model of stable, long-term work assignments, now is an on-the-fly adaptation to demand and offer. Work obeys a non-standard logic: a creative yet ephemeral and repetitive endeavor. Economics still tend to see labor as a zero-sum game: jobs created and jobs destroyed but this view is becoming far from sufficient. Davos Forum [WOR 15a, WOR 15b] published that *"Nine of the 10 most in-demand jobs in 2012 did not exist in 2003"*. "Automation has put low-skill jobs at risk for decades. And self-driving cars, robots and speech recognition will continue the trend". Douglas Rushkoff, the author of Present Shock [RUS 13], thinks that we have reached a point where "*work is really just a way of justifying letting people have what's already in abundance*". Is ever more artificial intelligence the salvation? Eric Schmidt the ex-CEO at Google addressed this warning: "*The race is between computers and people and the people need to win… It is pretty clear that work is changing and the classic nine to five job is going to have to be redefined…*" The crux is that value and worth are shifting from humans to artifacts, whereby human worth is attached to employment, professions and skills. People long for jobs and careers but industry is inventing new forms of trade. Human work is also prone to creativity and a degree of freedom.

10.2. Cultural factors underpinning work

Popular perception tends to oppose automation and (human) work. This is far from sound. On the whole, it is not only the work that should be

considered but also an *employment capacity*. Of course, we know about the new spheres for high skills demand such as data scientists, cloud computing experts, Internet of Things developers, software professionals, cognitive designers, innovation managers or blockchain specialists.

Man and robots are to mingle hand-in-hand under the agency of artificial intelligence and robotics for instance. The stable models for such partnerships are yet unclear as current studies show a lot of fixations (humans to do the care, the relation, the negotiation, etc.). Nothing is less sure. The key line may be the trio:

value creation, productivity, and innovation

Underpinning this key is education. How many jobs will you be able to entertain in your lifetime? Four or thirty? The ecosystemic platforms stir the work sphere and become dominant (e.g. New York's https://www.freelancersunion.org). We will actually study the possible evolutions by studying collaborative working or co-working in the next chapter. Semantically, these platforms replace work by *working*. In working, you don't execute a task, you sell a skill to somebody or something that needs it. Hence, the issue is the efficiency in monitoring our own skills set much more than managing our efficacy on a given task. Because the latter is best done by machines, intelligent machines and learning machines. These platforms will have to involve all types of education (engineering and artistic alike), via universities, private providers, firms and the public agencies.

The "liquid times" advocated by luminous Polish-born sociologist Zygmunt Bauman [BAU 11] are soon becoming quite gaseous, which is actually a Brownian movement. Society's states are very uncertain and this requires imagination beyond the borders of classical thinking. It requires thinking in an unknown space and this is a deep reason why we use C-K theory in this book. Just to capture the otherwise unthinkable. A design ability is becoming essential in breaking the status quo of old schemes and the rising cognitive skill that will govern other talents. It notably encompasses problem-solving which it reduces to a mere computation.

That society is becoming unpredictable is plain. From the ESPC Strategic Notes report: "*In the collaborative work culture and economy of the future, having broader analytical skills and knowledge, and being able to learn fast by linking up different perspectives from different disciplines, appears more*

relevant than ever. This competence is often referred to as T-shaped skills, where the T represents the depth of an expertise in a single eld, whereas the horizontal bar is the ability to collaborate across disciplines."

The Kirkus Review[2] (of the book by London School of Economics, Richard Sennet [SEN 98] "The Corrosion of Character" evidences the anonymity of work: work is transparent method-wise yet unreadable meaning-wise and emotionally: operators don't understand what they do: a vacuum is born between a human and its work. Who's at the center of the game? Not humans!

10.3. Work: background knowledge

Where does "work" come from? In the 18–20th Centuries, modernism was driven by technological advances, labor and rationalism. In late 20th to early 21th Century post-modernism, a switch to creativity (read already an alternative to labor), imagination and cognition (in lieu of strict technical progress) appeared. As a result, technologies began to focus on human beings, not directly in terms of productivity, but rather interfaces.

What factors impact work? It is *employability* which comes before any work can happen, revealing the issue that the problématique can't be "work" *per se*. Here, the mass digitization of the world and of work (whereby digital environments become proxies of the physical world, including virtual realities) is promised to an all-encompassing role in the form of information systems. In particular, new supply and demand is released by means of sensors and actuators. Which details new values that appear converting the data and analysis collected through the Internet of Things into instructions that feedback through the network to actuators that in turn modify processes. Closing the loop from data to automated applications can strongly raise productivity, as systems that adjust automatically to complex situations make many human interventions unnecessary. Where has work gone, then?

10.4. Fixations on work

The notion of productivity is a dominant concept bearing top value in macroeconomy. It implies that progress is subject to ever economic growth

2 https://www.kirkusreviews.com/book-reviews/richard-sennett/the-corrosion-of-character/.

and increasing consumption. But equity – the relatively fairer distribution of its benefits – isn't addressed then. Nor is any environmental regeneration concept taken up yet (which would altogether maintain productivity). Until we understand the complementarities between work/employment and "unwork" (whatever it could mean, which remains open at this stage), the notion of work remains entrenched in old schemes. Even the notion of unemployment is taken as the unbalance between jobs available and individuals who seek a job. If it were a true concept, wouldn't it need to deepen on a wider concept of distribution?

These are examples. New economic models (collaborative, circular, eco, "uberized", etc.) are now based on sharing functionality and on co-evolving through networks. In this context, what are the new boundaries of work? Should work become a politically (in-)dependent subject? With what form of governance? Should work be bound to some government role (e.g. regulation), be politically independent? And what type of social structure should work have? These translate into lifestyle issues which also reveal a "lifestyle growth". Below is a sketch for such vision.

Growth through a culture change

– by replacing throwaway culture

– by replacing resource intensive linear consumption

– with a change in mindset

– towards collaborative economy

- by lateral power

- with open commons collaborative social capital

– through expanding employment modes

- more flexible

- peer-to-peer task sharing

- remote work

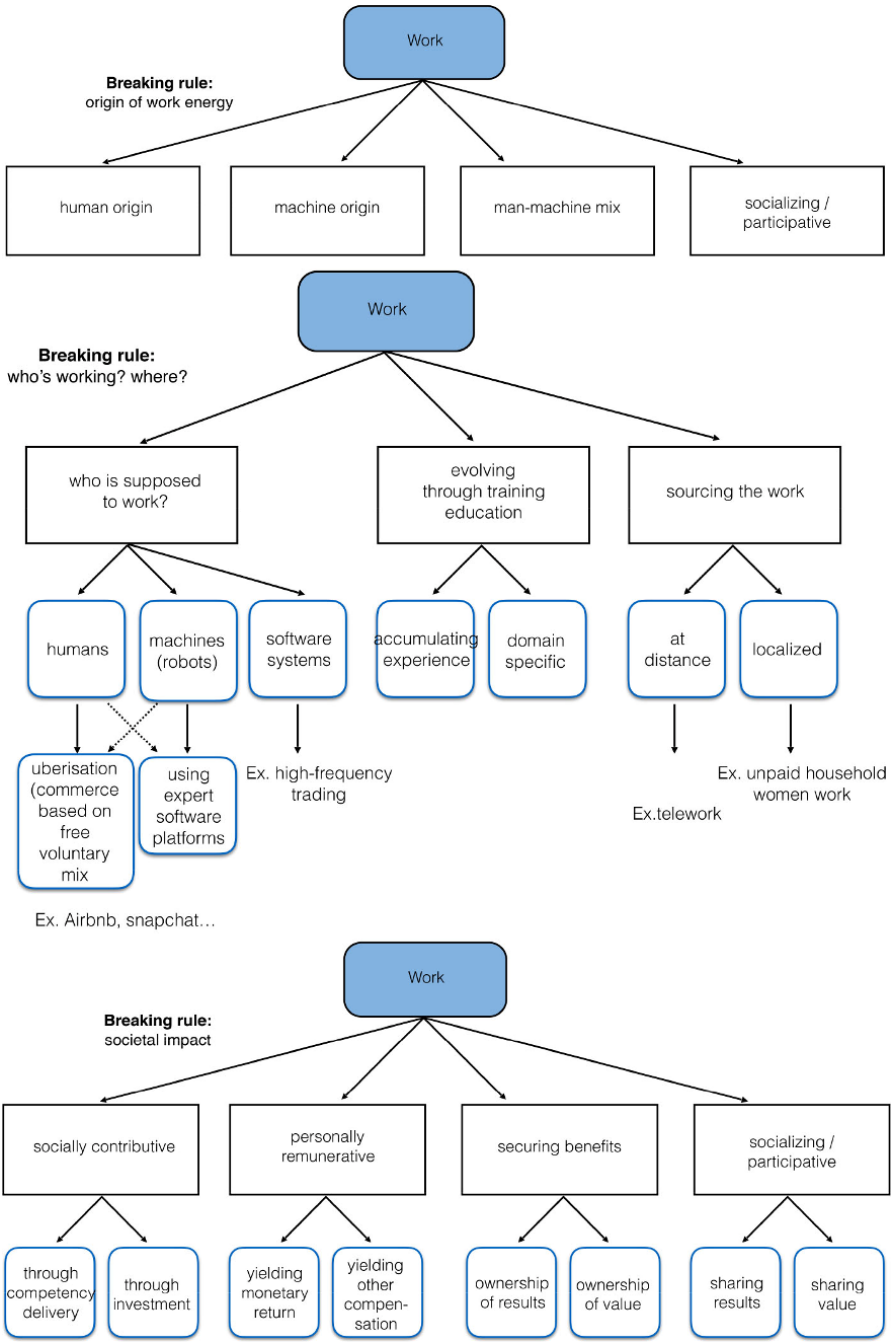
- service oriented

- "small tasks"

– income generation

10.5. Work: dominant designs and breaking axes

The history of work shows that there exist trends: employment has evolved into various forms of activity, under the pressure of digitalization and people's expectations (e.g. flex security, the Harz laws in Germany, the workfare in Great Britain, etc.). And the shallow notion of co-working is a prelude to the emergence of new professional communities. Here are a few views on some dominant designs of the concept of work.


Work
Breaking rule:
origin of work energy
human origin
machine origin
man-machine mix
socializing / participative
Work
Breaking rule:
who's working? where?
who is supposed to work?
evolving through training education
sourcing the work
humans
machines (robots)
software systems
accumulating experience
domain specific
at distance
localized
uberisation (commerce based on free voluntary mix
using expert software platforms
Ex. high-frequency trading
Ex. unpaid household women work
Ex.telework
Ex. Airbnb, snapchat…
Work
Breaking rule:
societal impact
socially contributive
personally remunerative
securing benefits
socializing / participative
through competency delivery
through investment
yielding monetary return
yielding other compen-sation
ownership of results
ownership of value
sharing results
sharing value

The old repetitive, alienating labor view is slowly being dissolved by a new culture of work. What about machines and robots: is a street cleaning machine doing work and should it be retributed? The European Parliament has forayed the notion of "electronic person" with rights and duties in a comprehensive report [EUR 16].

And what is the contrary of work: Unemployment? Idleness? Leisure? Entertainment? There seems to be a moral view underpinning the concept of "work" (the incentivization with respect to just work). Which reveals that the legal framework isn't far behind the steady view of an activity, hence can it include the different forms of work? All this shifts the notion of productivity beyond the workers (material), and the knowledge workers dear to Peter Drucker. R&D (and in particular invention) was considered as a cost impacting future work thanks to new tools, products and methods.

With a highly dynamic societal context due to (1) Internet (i.e. connectivity everywhere for everybody), (2) robots (i.e. a hybrid society), (3) artificial intelligence (i.e. skills, competencies, learning, impact on education), who works and who doesn't?

10.6. Blueprint concepts for extending the notion of work

Form the above, if we reason by analogy, work is subsequent to the notion of management, i.e. the fact that work can be divided (task decomposition) and allocated in chunks, conversely that it can be the target of several workers at the same time. Hence, the notion of work is subject to the arithmetic operations of addition, multiplication and division, and traditional management is the art and science to control these.

With this analogy, it becomes possible to play arithmetic to "growth", with a view to create new continuities. For instance, the cut-and-link mechanism for growth can be instantiated by using biomimicry for designing new products: bio-inspiration tells, e.g. to model the whale's fins to design a wing for a wind turbine. The sub-category of products named "wing" has been divided into "wind turbine wing", the sub-category of "fishes' fins" into "cetacean fin", etc. And the link between fin/water and wing/air & wind has been created, whereby no existing taxonomy would have permitted to do so and no growth window would have been detected between fishes and say wind objects. There exist already countless bio-inspired examples leading to

new economic sub-categories and each of them can be accounted for a grown-up one.

10.7. Expanding the notion of work towards a cooperation principle

Whenever interactions happen between humans or organizations, there exist local or global interests for the parties, which trigger one or more strategies. Competition aims at preserving a local or individual interest. Cooperation pushes their parties to share their capacities and needs with a view to reach a shared satisfaction.

Can individual and collective aims be reunited somehow? Adaptation seems the continuous modus operandi for suppliers as well as customers. By reuniting the two basic strategies sequentially, we develop two new strategies: “Coopetition” and “Comperation” (see Table 10.1).

STRATEGY	1. Cooperation	2. Competition
1. Cooperation	Cooperation	***Coopetition***
2. Competition	***Comperation***	Competition

Table 10.1. *By combining the two basic strategies, two other strategies emerge*

With the following definition:

– Coopetition: suppliers begin to cooperate, even partially as to build a commons. To exploit them, they can later become competitors. It is a product-oriented principle.

– Comperation: suppliers strive to obtain maximum market advantage based on their individual interest. At such point, when e.g. price competition or production cost become prohibitive, they modify their strategy, they adopt, at least in part, the cooperative principle as to federating or negotiating production or distribution means. They help each other to remain in business while demand may vary. This is a resource-oriented principle.

As far as growth is concerned, the coopetition principle favors demand while comperation favors supply.

10.8. The fixations on money

A simple sketch for representing money is shown here:

Money – the traditional view

– a good

– which price is the interest rate

– an agent of fluidity

- how to install fluidity?

According to Lietaer [LIE 02], money as a concept is fixed three times:

– its intrinsic *rarity*: limited by definition (except recent measures on quantitative easing);

– the encouragement to *concentrate* it: the tendency to savings in some material or investment form;

– the *competition* it generates.

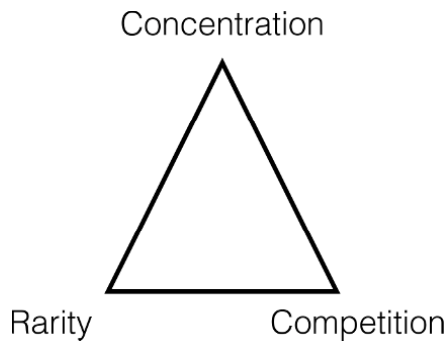


Figure 10.1. *Bernard Lietaer's triangle characterizing money*

Figure 10.1 summarizes the three factors fixing the traditional characterization of money. Let us instead take a very different view. Consider money as a collaboration concept. A bit as it were a specific energy. Add to that concept the caring attitude of this energy by which we create exchanges in the present (the usufruct, not the property or sometimes in the future). The result is we tend to increase the propensity for change.

The Indian philosopher Sri Aurobindo[3], twice nominated for the Nobel Prize in 1943 and 1950, used to say "*the only money you have is the one you spend*". It may be difficult to grasp his words, although their simplicity says in a sense: make money circulate and money will not lack, his motto: keep up the movement of the usufruct of money.

We view money as the universal solvent that is able to structure just everything. How many times in our times of quasi-religious low-cost attitudes we are buying goods, not so much for the good itself, but for its price! The price, not the object? How to be satisfied then? If we don't give value to goods, how can we give a value to our self, ourselves? This is what we meant by "inner growth": give value to yourself first, or you will end up ever discounted.

Another enduring dominant design of our society: that money is linked to labor. If we view money as a concept, labor is just subsidiary to it and money can be generated by many other means. Of course, the pure financial yield is one possibility, but fundamentally the circulation of money roots money. Because the concept here is not the property but the usufruct. We would call for a sort of pact with money: that it be considered as an energy source (another utility if you wish, like water, electricity, Internet, waste, etc.) and that it be bound to solely interchange, in a contemporaneous mode, so to favor a circular movement, i.e. in reality a spiral.

Let us take one of the principles discussed earlier: the lowest point of leverage, and apply it to money. In this case, it is the situation of the precarious. It is essential to work on these because it will unlock the faculty to project growth. A contemporaneous example is the immigration trend from some European countries to members states within the European Union. Many immigrates in personal difficulty represent that symbolic lowest flexion point. If we were able to project the maximum dynamics in them, we would engage a huge work force, generate a powerful actuation link and presumably obtain huge growth. To obtain the maximum yield, we need to make contact with the symbolic "lowest point", which only enables empowering us with the maximum dynamics. It is not only a matter of equating with formulas, we also need to add that.

3 https://en.wikipedia.org/wiki/Sri_Aurobindo, as of March 23, 2017.

The virtuous effect is that we eliminate stagnating economic effects. A particular case is the much debated universal revenue notion: it is important to be careful to not encourage patterns that induce stagnating attitudes and conducts – should we still desire overall growth piloted by humans and not artificial means such as robots and smart algorithms.

The ethos of the economy should be based on that lowest point. See an uberization effect: it attacked a bottom fixation and neutralizes it. In the case of Uber, the change is too radical for our state regulations: Uber breaks the dominant design of reserved local transportation (a referenced taxi status while people still have to wait for having a cab where they need it, when they need it, while cars are so abundant as to clog cities – what a paradox!) Does Uber destroy the economy? Well, at first and in a sense yes, but it generates a bigger one and by the way it moves the money around in good part.

11

Case Study: Growth Through Cooperation, Work, Time and Space

> "To be successful in high complexity challenges requires teamwork. Each team member performs one part of what needs to be done, contributing to the complexity and scale of what the team does while limiting the complexity each individual faces."
>
> Yaneer BAR-YAM, NECSI

11.1. Evolving work in co-working settings

In his recent "Teams: A Manifesto" post [BAR 16], Yaneer Bar-Yam, the Director of the Boston-based NECSI Complexity Institute solemnly addresses each of us as a team member whatever the scale of operations by saying:

> "The increasing complexity of society means professional and personal endeavors will be done in teams. Teams will range from a few individuals to many, in one place or spanning the globe. They will differentiate roles–sharing responsibility for decisions and actions. […] Society has to coalesce into local and global teams".

And he distinctively adds:

> "Can we say 'we' about ourselves to become a collective, with a collective identity?"

Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter, First Edition. Patrick Corsi.

Envisaging growth through future collaborative work modalities that evolve working spaces with a method – that is the subject of this chapter.

The general applicative theme is to find some "advanced co-working" (say 2.0) and seek to quantum leap current co-working practices (from 1.0 models) by ideating novel models for co-working. With co-working 2.0, we want to augment the co-working practice by creating two vaults:

– a common transferable knowledge vault (KV) referencing past and present knowledge, as well as local and remote experiences;

– a concepts vault (CV) that taps on the previous KV and continuously expands it.

Exploring new collaborative work and control modalities entails revisiting the inherited project management legacy arising from the Industrial Revolution. Whereby people may not collaborate easily, being bound to intellectual protection behaviors, classical project management techniques, and disciplinary or branch views (e.g. engineering, marketing, finances, manufacturing, etc.). As knowledge became a core asset in the society (recalling the notion of knowledge worker first introduced by Peter Drucker in 1952 [DRU 01]), the evolution of work cannot be stopped: there are convincing facts showing that innovation is best realized when new ways in experimenting co-working and co-learning are allowed. Which leads us to relate work with space and in collaboration.

11.2. Why co-working as a subject matter?

To begin, here's the first conceptual definition of a collaborative working space (CWS):

A working space for common use that can be used as an à-la-carte office by any knowledge worker

Box 11.1. *A liminary definition for a co-working space*

Organized patterns of work express behaviors that arise from the interactions between people. Social networks reveal same emerging patterns almost independently from locality and time factors. How we can *think* about people working *together beyond* is the subject matter.

A working space traditionally influences how work can be accomplished within organizations. With the advent of Internet-based networks, the social activity called networking gained a new and enlarged definition where communication got augmented with a capacity, not only to communicate, but also to co-operate and collaborate with ever more participants remotely in ever increasing sizes of ecosystems of stakeholders. Where system feedback thinking applies at the local level, as local co-workers reinterpret their roles, relations and dynamics locally to the measure of the larger environment within which they live and work. The environment is co-substantial to the individual and both co-evolve by reciprocally cross-infusing implicit knowledge.

In simpler words, a working space is no longer a space where people merely work! It's become a spatiotemporal resource where agents interact within ever changing modalities. And this is what we would like to call from now on a "co-working space". Issues are:

1) How to evolve these from the recent co-working models that have emerged in many places of the world in the last few years?

2) How to design the new 2.0 varieties that creatively evolve and differentiate from what already exists and with what features?

11.3. Generations of co-working spaces don't act on the same premises

Co-working spaces (CWS) traditionally include open spaces and closed areas for sharing work situations among people who may know or not know each other. By fostering attitudes of openness and sharing, they intentionally support and vitalize the creativity of those present. Numerous formulas have been tried around the globe in e.g. larger cities, and their number can be estimated in the thousands, to grow at 100–300% per annum depending on the country. The quantities of unused office spaces lead to accepting huge growth potential for co-working spaces in the cities.

Yet, these spaces have rules that separate – if not isolate – them from "mainstream spaces", i.e. "normal work areas", be they offices, cubicles, meeting rooms, hotel-based facilities, etc. *First*, they are subject to reservation policy, or alternatively, co-workers are allotted an open space where they obey an implicit policy. *Second*, they don't concurrently accommodate those who join for a short period of time (by e.g. attending a

conference) and those who tend to use them as their main office for a longer period, if not by allocating them physically differentiated areas. *Third*, they resist customization with respect to the needs of specific populations. Not speaking of privacy and confidentiality policies and issues that may likely be left to the appreciation of incoming visitors. On the whole, 1.0 co-working spaces remain ready-made loose areas hosting people space- and time-wise. We argue this is a temporary view.

Our postulate is that future co-working spaces will regenerate the whole lot of the work environment concept, and that today co-working spaces should be considered as just odd seeds for tomorrow. That they shouldn't be seen as singular zones for rare people over an exceptional time duration, but rather as *rich working modes of the future:* original, variable, valuable and robust.

Co-working spaces (CWS) of 1st generation

Mission statement
to make a working real estate *a priori* available anytime for visitors, incl. by reservation

Contingencies
Space and equipment are usually not dynamically customizable with respect to usage intensity and type, public types… Privacy and confidentiality not easily addressable…

Box 11.2. *Some salient principles of a co-working space of the first generation*

Our early observations give credit to such view: mobility has grown ubiquitous among working populations and offices are much on-the-go; ties between different physical settings pop up, grow and fade unceasingly, and the cost of renting and furnishing working spaces in large cities has unavoidably raised to heights. When Starbucks opened their in-shop WiFi offer in the US more than a decade ago – i.e. an Internet-connected space on a table for the price of a cup of coffee or a monthly rate membership – they just opened up a new market:

> "*An own pop-up and mobile office for me at quite every street corner in the city where I am now*".

Better spaces – with coherent, functional and evolutionary functions – have been ideated since, as they tend to facilitate synergies between people. What a variance with the long hauled yesterday's vision of e.g. a nascent Microsoft "*A computer on every desk at every office and home!*".

We advance that future CWS should possess intrinsic augmentative capacity in terms of redeploying space, time and people synergies – concurrently. Where space, time and other resources (e.g. capacities, competences and skills, money) become *energy*:

Co-working spaces (CWS) of next generation:

Use and alter space and time conjointly – enhance and augment local possibilities – enhance people's and all resources' synergies

Box 11.3. *A few factors that may lead to conceiving future co-working spaces*

Here applies the following citation from Schmid [SCH 12]:

> "*Spaces that have a structure (...) are the modalities according to which design takes account of, and distances itself from, existing objects, so as to create new ones. Whether it is a combinatorial space, where properties can be decoupled, spaces of diffusion allowing the transfer of a property of one discipline into another, or logical and non-logical spaces to combine concepts and scientific expertise, these spaces can be described by mathematical structures, topologies, combinatory algebras, algebraic extension. The notion of space or of site is more scientific, even in the effective reality of its practice (the site of the laboratory, the site of the collider, etc...)*".

Along this path, a co-working 2.0 concept gets heightened to the status of an ecosystem enabler, and may look as a free form space without time limitations, or an enabler of synergies among individuals – professionals and not – and formal and informal organizations. In short, a seed engine fostering tomorrow's socio-economies, somewhat in the same way electricity dispatchers fueled manufacture yesterday. For and because of which, they should be founded on knowledge-based views – the engine of the rising economy in a post-industrial economy [DRU 92, DRU 93].

11.4. Departing from some current views opens up future co-working spaces

Although modern working spaces and working modalities have been forged since the advent of the Industrial Revolution, we first need to dismiss two very classical working modes: meetings and business centers.

Believably, working meeting settings have been so frequently used since the advent of the Industrial Age that they form a part of our living work style. However, what do they have in common with CWS? The only viable "meetings" are the spontaneous (unplanned, *ad-hoc* and evanescent) social gatherings that people form to share feelings and information. A reason for spontaneity is that participants usually come with different and peculiar ideas, projects and backgrounds unknown to each other. Then, the business centers' view has been existing for a few decades, for instance in urban areas' hotels for the following reasons:

– they are a fixed office available to a guest usually with some amenities for working (e.g. equipment with stationary supply);

– they generally are stand-alone (deprived of augmented service);

– they are on restricted first-come, first-served access, sometimes on a reservation basis.

Instead, CWS enhance freedom and independence and cut through the isolation of the worker, plus usually bring in useful amenities on demand.

Seeking to bring above novelties requires expanding the conditions for adequate workshop animation. Which leads to defining classes (a typology) of CWS that can operate with 2.0 properties (e.g. be evolvable, duplicate easily). What then are the key definitional attributes that may reside hidden behind form factors? Can we perhaps design CWS taxonomies for local or temporal adaptation?

11.5. Using C-K theory for thinking future co-working spaces

C-K theory is an axiomatic of design reasoning. It is capable of accounting for (detect, explicit, trace and trace back) the *innovation moments*, i.e. the locations in the progressive conceptual expansion where an innovation potential occurs. And these are made possible anytime via expansive partitions

that force the breaching of partition spaces, a gapping ability to create breakthroughs that revise the identity of the objects under investigation.

The gist is that cognitive fixations are the locks on the path and often remain invisible to the practitioner and therefore resist their breaking up. "Aha" moments customarily happen when such a block has been removed. The detection of fixations is one workshop process objective (the other being cognitive debiasing).

Therefore, using the C-K formalism was motivated by two requirements:

– a capacity to generate a high degree of creativity in designing novel co-working environment (CWE) concepts;

– easing the management of the projects resulting from the C-K development.

By reviewing existing models, methods and practices for doing CWS, we gradually structure the knowledge acquisition pertaining to this thematic. We call K0 a state-of-the-art on the co-working thematic.

The three definitions (Boxes 11.1, 11.2 and 11.3) for a CWS concept contain implicit assumptions. One is that the concept should enhance two factors: the creativity and network readiness of the worker. Another implication is that it should host a mix of profiles with different skills. Yet, it remains evident in practice that much of the value to be found in a co-working space may still fall outside of the above definition.

11.6. Giving thought to today's 1.0 co-working spaces

What is the status of today's co-working space? Probably a form factor for doing work that requires a few resources, e.g. energy supply, comfortable physical accommodation and a few people whose implicit agreement is to obey a number of implicit rules:

– given physical settings preempt custom needs;

– time is allocated and can't be projected freely.

A CWS creates ruptures with traditional economy thinking. As it hosts people from different realms, it offers a cross-sectorial view of business, therefore smoothens traditional business sector boundaries and creates links

in between that will possibly cross-fertilize both the sides. The importance of crossing cultures in innovation should be seen by the measure of exploiting unearthed dormant business areas. A CWS can be envisaged as an experimental laboratory compositing multidisciplinary teams bottom-up.

We haven't found fundamental classification methods for CSW beyond the list of innovation hubs ("cantines" in France), cafés/tearooms/theaters/… boutiques, restaurants-cafés-stores, "innovation boutiques", possibly the living labs, etc. Examples are: the many hubs in all the major cities in the world (to name only a few, London, Toronto, Berkeley, Brussels, Sao Paulo, Milan, Zürich, etc. – often called "cantines" in France (http://reseaudescantines.org/), the living labs (http://www.openlivinglabs.eu), the FabLabs (fabrication laboratories – open spaces dedicated to digital fabrication of prototypes by individuals collaborating or not), the innovation boutiques, the start-up stores, the variety of café-bookstores, distribution centers meshing café + restaurant + press + grocery and more (see the international Italian Food and Recipes Eataly concept with regards to slow food, etc).

In summary, the concept of a co-working space is quite content-rich and spans a variety of forms:

Co-working spaces, meeting places, presentation and informal exchange locations, sharing of experience, animations, experimentation of usages.

Events organization, barcamps, trainings, meetings, press conferences, creativity sessions, new technologies presentations, new concepts experimentations.

Modularity, friendliness and conviviality, relaxing.

Stimulation of entrepreneurial initiatives that resonate with social, environmental, economic and cultural challenges.

Box 11.4. *Co-working spaces' forms are manifold in features*

11.6.1. *What's critically missing in current CWS interpretations?*

As their name induces, are CWS really spaces? And where's time represented? If innovation is all about timing, how do CWS articulate and warp time to produce effects? Whereby participants are supposed to be immersed in a global experience thanks to a CWS, time becomes intermingled with all the resources including space: other participants, equipment, financial means, the environment, etc. But what's missing is a double intelligence about:

– the way to organize co-working processes;

– the ways to globally approach endogenous interactions with exogenous factors, such as the environment.

11.6.2. *Limits to the concept: is this a co-working space?*

The limits to the study aren't easy to define at first, and leading architects sometimes bound themselves to no rule when extrapolating common notions. Take the concept of a working building for instance and see what an architect came up with in following figure. Can this building represent or somehow become a co-working space? Arguably yes, as "*surface is folded in an endless Möbius band, floors transform into ceilings, inside into outside {…} A home that has no beginning and no end*". It even seems to fit many of co-working prerequisites. And what about printed homes: can we print a SWS?

Or perhaps, this one:

Quite naturally, if you want to see inner growth at work, enter a recent Apple Store and mingle with the individuals. Apply then the model to the economy at large, shake a bit and voilà.

And what to think of the so-called Apple's Space Ship, the last and legacy ideation of the late Steve Jobs? Isn't it meant to offer one co-working space to 13,000 Apple core employees plus it received 16,000 planted trees as well in the heart of Cupertino in California.

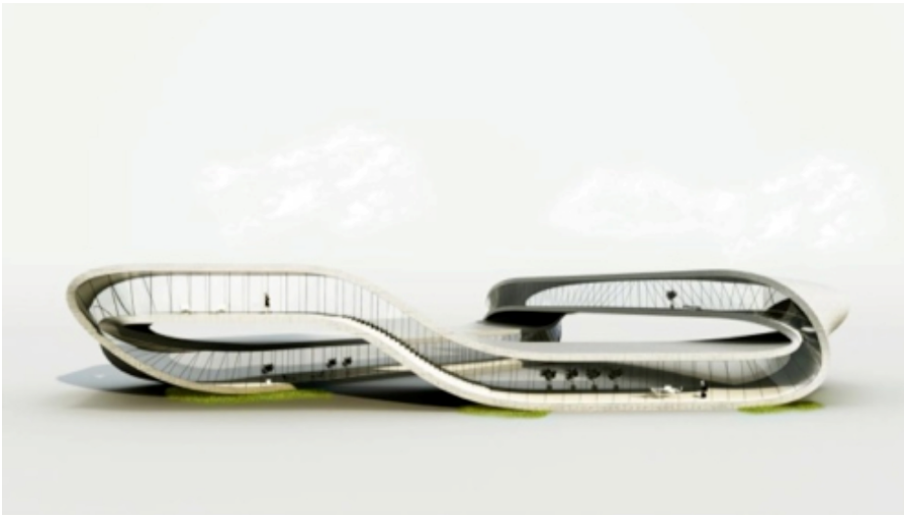


Figure 11.1. *Can this be a co-working space?*

Figure 11.2. *The Brussels Apple Store a couple of days after opening in 2015*

11.6.3. *Extending and reformulating the state-of-the-art for more conceptual expansions*

The first phase as we implement the C-K theory is to review the conceptual definition of a CWS and embed it into an ecosystemic understanding of the design activity. This requires us to reformulate the concept of CWS. In order to scope the perimeter of a CWS and tune the objectives assigned to the present study, we first focus on the implicit values evoked above and ask the following three questions:

– "*What are the underpinning factors at play for a CWS?*"

– "*What are the available pockets of knowledge that exploration may lead to uncover new possibilities?*"

– "*Which incoming weak signals may appear, what they may reveal and tell us?*"

Figure 11.3. *An initial artist depiction of the Apple headquarters which opened in April 2017, alias of the (mother) Space Ship. From MacRumors, https://www.macrumors.com/2013/02/28/what-apples-and-googles-headquarters-plans-reveal-about-their-cultures/, as of March 27, 2017*

11.6.4. *Structuring the K space for opening up ensuing C expansions*

We summarize below the knowledge thinking by listing seven major findings:

1) The important factor of a CWS is its ecosystem in which it operates explicitly and implicitly.

– A corollary is that anything that isolates something or somebody (a subsystem) works against the ecosystem: here, relating and socializing are two paramount factors not working alone.

– Advancing CWS research is akin to studying ecosystems with system feedback thinking.

2) The networking operated by a CWS should be effortless, i.e. be a given for any person entering it. A corollary is that the networking friction (dissipation of energy when networking) should theoretically be zeroed.

3) The two fundamental laws of networks should operate best in a CWS:

– Law of Metcalfe: it states that the value of a network – i.e. the ability to connect nodes from any peer to any peer – grows with and equals half the square number of its nodes.

– Law of Gilder: it states that network bandwidth – i.e. the potential for communicating – grows exponentially with time.

The consequential communication capacity growth is three times faster than computer power, which signifies exponential increase in business exchanges through networks – a deployment key to future co-working spaces.

– A corollary is that ideas flow in a CWS in rapport to the performance of these laws in a given CWS. Measuring a CWS should therefore be based on measuring the qualitative and quantitative flow of ideas, the synergy level between people, etc.

4) The culture that permeates a CWS participates to the innovation made possible.

– A corollary is that a CWS will attract people in resonance to that culture and less others. Then, what about people in dissonance with the existing goals: filter them out? Insert them as rich noise?

– Hence, the profiling of a CWS is a key activity when designing one.

5) The mutualization of resources that bases a CWS should be a multiplying factor for the present and not a divisive one. For instance, cost: participating expense should be a fraction of what it costs to work alone, let alone the possibility to vary the intensity of work and working relationships and use of the facilities in space and time. The business models behind are first based on rental parameters and not buying ones, then on mutualizing the objects and services available not on exclusive usage.

– The first corollary on using CWS equipment is that its usage intensity should be far above what an individual can do with it. Speaking of office equipment seems easy; yet, if we translate the model to non-office objects that people tend to own in full, e.g. a car, garage, gardening machines, etc., the reasoning leads to quite diverging views compared to today. CWS foster a sharing economy with far reaching implications.

– The second corollary is that the full range in modularity in usage, time- and space-wise, is made accessible, thus fitting the demand of a widest array of professions.

– The third corollary is the looseness of relationship with participants: they perhaps want to be full-time members, onetime visitors, or anything in between, and at any moment.

6) The displacement factor when using a CWS is such that a person comes to it. What if a client instead comes to it too, therefore contributing to the co-creation of a solution? Surely, a client would require and deserve exclusive space, and therefore a CWS isn't the best solution.

7) The social boundaries between work and pause blurry. Participants to a CWS may have lunch together, share anything such as news and information.

11.6.5. *Summarizing this thinking*

The above approach results in the following three key points:

1) CWS should dive into larger ecosystems.

2) Relating and socializing require system feedback thinking.

3) Variable geometry is a generic design factor that encourages an ability to accelerate exchanges and sustain communication through two features:

– effortless participation plus looseness of relationship;

– mutualizing resources.

These points can now be compacted into the definition of a new C0 concept that embodies an undecidable status (can't say whether it's true or false, yet can't prove it's impossible). This C0 shall represent the origin point for developing the C-K approach. We reformulate the initial C0 root concept for co-working as follows:

"*An open and free time access space that is pre-structured to favor the meeting, the communication, the cooperation, the coordination and the collaboration between several fortuitous persons that favors the:*

– inventive faculties of the individual, inclusive of surprising ones,

– discovery and innovation for individuals and organizations."

Box 11.5. *A radical C0 concept to start-off the C-K process among all groups*

11.7. Mechanisms for expanding the original concept

A CWS is a return to geometry (the rooms, the halls, the various spaces) and continuity (how to spend space in time and time in space). It is hence a spatiotemporal construct inhabited by people with intentions and possibly a mission. It contains physical attractors (e.g. the coffee corner, possibly sofas and rest areas, etc.) as well as repelling elements (cold areas, stairs, dark spaces, etc.).

There are as many ways to think of a CWS as disciplines. Mathematically, a CWS system is a dynamic and transformative energy space set in a differentiable volume with singularities, bifurcations and attractors. At the significance level, it is an object that synthetically tells something to a visitor. At the usage level, the user of a CSW sees a multidimensional volume at disposal. At the architectural level, the concept requires an evolved definitional grasp. At the societal level, it needs to have a clear status that breaks down at legal, operational, managerial and usage levels.

However, we here focus on the design level only, which entails the following issues:

1) How to "fill" a co-working space with objects and with people?

2) How to deal with its singular spots, in particular where are potential communication ruptures and how are they "awakened"?

3) How and thanks to what does it engage into "key moments"? ("Aha" and "lost" moments)?

4) What are the dynamics of its habitable space (we call them the energy gradient potential)?

5) Does it contain a time delay rule?

6) Does it contain a Maxwell rule (competition of two attractors)?

7) What about possible space extensions?

8) What are the stimulations that can be used?

The sciences at hand to resolve them can be termed under the general vocable of "biodynamics" and include embryology (e.g. how ideas are born and grow), physiology (e.g. the ways to occupy space), psychology (the internal form factor determines grasping factors), ethology, sociology, linguistic, history, etc. Should the sciences behind these disciplines be advanced enough, we would possibly tackle issues such as optimizing a CWS usage based on its architecture and other external factors. Reason is that a CSW is an object that our brain and our entire being "know" how to comprehend. This is an important aspect of design by which an object "tells" the user how to be used (the skeleton form factor plus the wavefront).

11.8. What may be a language for "working together?"

The above discussion tends to indicate that we even need a language to express co-working spaces, which is to find a communication vehicle that unifies the co-working object despite the vast array of its deformations. In other words, one that accounts for the differences in form. Such a language would reify the CWS by starting from morphological information and conversely would help find underlying dynamics that enable us to generate it as a system (probably through a gradient method). It should be apt to

describe continuous and discontinuous progressions in space and time – a language of space and time.

A CSW alphabet or algebra may be invented for the purpose of simulating CSWs. Simulating such objects with the alphabet would be far more interesting than cartographing them for the reason that simulation can support the generation of new CSWs. We can't predict what will be the evolution of CWS, but through simulation, we may show factors that tell us something.

11.9. Founding experiments – the protocol and schedule

A comprehensive workshop was organized at l'Ecole de Design de Nantes Atlantique. The general C0 given at the beginning of the workshop was simply "a 2.0 co-working space". By 2.0, we possibly meant "something smarter", e.g. "intelligent, evolutive, dematerialized, etc.". It was up to the groups to coin more valid C0s for engaging into their C-K process. Defixing views about CWS meant letting go a number of constraints (such as topological discontinuities in rooms: angles, stairs, ceilings, etc.; static rapport to objects: "*I am here, they are there*", neutralizing gravity. Co-working spaces may indeed neutralize some fundamental principles of physics, although not reversing the laws of physics however!):

– gravity;

– discontinuity: angles, floors;

– rapport to the object.

In what sense do the co-working concepts obtained extend or go beyond the traditional co-working concepts?

– Include the notion of space (hopefully) in a different way;

– Include the notion of partnership (hopefully) in extended ways;

– Include a number of open innovation principles; and

– Merge CWS with virtual environments (VEs).

For instance, a CWS could be a "home-based zorbing-like" (see Figure 11.4), with its possible variants: moving, on water, etc., that is a

generative syntax for CWS. The “Aha” moments (“Light Bulb moments”) were carefully noted by the groups.

Students opened new issues such as metaphors that materialize potential couplings between competences (represented as bubbles) and demand. That CWS should obey the “law of required variety”, i.e. their design potentially accommodates all possible behaviors from participants within a given ecosystem.

Figure 11.4. *A gravity-defixing zorbing-like seen by the students of the collaborative working spaces workshop*

Then, there seems to be a two-way relationship between the morphology of a CWS (which after all is an embodiment of an organization) and the viscosity of the cultural life that goes along with it. Structure and systems should be a part of the strategic design of a CWS, while culture is the dual factor that develops with time and will create habits to later be lived with, for the best or the worse.

We therefore consider the following criteria:

– Feasibility criteria: technical, architectural, commercial, etc.

– Usability: workability of a CWS.

– Accessibility of a CWS.

– Readiness of a CWS. This is a global criterion that includes access, independence of the subject matter, networkability (be connected to a network of other co-working spaces), integrativeness and capitalization (each experience is integrated), and augmentation (to leave the co-working space by leaving behind more than you find when coming, this each time).

– Networking ability (linkability): number and variety of links between actors of a CWS.

This is the capacity to create new knowledge about, from and for the stakeholders of a co-working space:

– users;

– managers;

– architects and designers;

– suppliers (energy operators);

– partners;

– associations;

– public authorities;

– operators.

Principle of the integrative object [SCH 12]. Science as a creative of objects versus science as a system of proofs. If we do not accept the integrative object, what we can say of the sciences is impoverished to the level of disciplinary structures and the epistemology of theories. From the point of view of the relations between philosophy and design, this signifies that philosophy stands in a position of survey or of foundation in relation to design.

Principle of Genericity (transformation of disciplinary elements: one does not bring together two disciplines without some transformations). If we do not accept genericity, interdisciplinarity is a matter of the combination

and transfer of disciplinary expertise. From the point of view of the relations between philosophy and design, this means that the totality of the system must articulate itself with a mathematical space – a ponderous, unwieldy machine.

Weaknesses found are in:

– defining C0s that have stronger triggering power;

– maximizing the innovation potential;

– pruning out the knowledge produced in excess.

11.9.1. *Evolving the results obtained: socio-economic implications*

At the socio-economic level, several factors mesh that contribute to bringing co-working centers to the social status of organized bodies. Appropriate legal statuses are yet to be invented and the sooner will be the better. As CWS strive for visibility and reputation, there is probably going to be a competition between them. However, the competitive environment in which they have been developed is highly complex (systemic and resorting to complexity sciences). The reasons are multiple:

– a variety of members and sometimes cultures; the participants are interconnected, likely will be living in cities, are used to manipulating huge quantities of data, information and knowledge, and often travel extensively;

– causal effects generated by a given CWS will more and more entail the participation and involvement of other CWS, etc.; the business models involving an array of CWS are yet to be defined, lest understood; these will account for a quasi-impenetrable web of tangled operations beyond space and time;

– as a result, they will be most flexible, far beyond what structured firms can normally do; agility for a CWS is a given, not for a genuine company; this has origins in the softer legal binding among members, and it is expectable that value is realized anywhere beyond it as opportunities appear;

– the technologies in use at a given CWS will generate more innovations that classical structures in firms ever can; the man–CSW relationships will overcome any other well-known type of contractual or non-contractual relationships, e.g. employee–firm, person–community, or individual–society.

Hence, the CWS may well become the mold of reference for originating any new form of organized community living, thus escaping the laws of established legal community patterns.

11.10. Concluding with some considerations for the future

All of us have been deeply used to the world of product design, and we are now under the process of designing new and collaborative means to enhance end-user experience. The co-working space of the next generation is a key part of them. We strongly believe that virtual reality, augmented reality and immersive virtuality are technologies that will develop the design of future CWS.

One novelty brought was to offer a universal design front-end based on implementing the C-K theory, a pre-process bringing a novel and highly generative capacity for generating lineages of breakthrough concepts. We also stressed the need to defix concepts and brought mechanisms for so doing.

Many approaches for designing experimental working environments still reflect dominant design paradigms. Reason is that, while they acknowledge the need to mobilize appropriate knowledge from the field, they resist calling for systematic conceptual expansion and capitalize on known knowledge primarily. What may come as a surprise in most innovation situations is indeed recommendable when dealing with VEs. These still represent a formidable and relatively uncharted exploration: they inherently constitute a whole creative and uncommon event where experience is the sole accumulative guide for users and developers alike.

These dominant design approaches reflect the relative maturity gap of VEs compared to physical world objects. We here anticipated ways to pre-design CWEs with a view to enhance the future maturity level of the corresponding VEs that may implement them. One anticipated demand is to foster co-creation contexts. Our view was to show how dominant VE design can evolve towards a VE design innovation paradigm by virtue of using a C-K approach appropriately.

The co-working spaces that have been conceived tell much of the future ways of working, relating, even socializing. They might well represent the meetings of the future: no longer meetings, but actual workshops, even economies. And growth potential lies therein. Moreover, the spaces becomes *sites*, i.e. systemic environments.

At a management level, two options prevail. One is classical management, which aligns with dominant design situations. The other, which we would recommend, is "open" management, whereby objectives are forged and refined all along the projects' life span, which aligns with design innovation situations and where the operations seek to develop value to the ideas generated during the process.

11.11. Acknowledgments

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12

A Society's New Clothes

> "Without continual growth and progress, such words as improvement, achievement, and success have no meaning."
>
> Benjamin FRANKLIN

12.1. The main messages from this book

What a world in transition! From the initial 1972 Club of Rome report, about half a century has elapsed. This has brought more change to humanity than several centuries before combined. In the meantime, many visionaries and scholars have paved the way to the future. One of them is Peter Drucker, who, in his very last opus, and probably not having himself found a better word, proposed the advent of a "post-capitalist society" [DRU 93]. He wasn't very well understood, and his essay was almost never referenced! More recently, it is Jeremy Rifkin who has tirelessly advocated the advent of "distributed capitalism". Yet, the views are much clearer now that we have the Internet of Things, smart systems and cognitive robotics, and other blockchain, etc. technologies, all rising to the fore, ready to lead humans forwards. This makes for a huge change.

As technological changes are inextricably linked to changes in mind-set and socio-cultural shifts, the consideration of the human dimension and the search for common values should frame the transition to a sustainable socio-economic model.

Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter, First Edition. Patrick Corsi.

But the fundamental difference between the early 1970s and the late 2010s is not so much technology. It's that people are now listening, or better put, forced to listen seriously. A sense of urgency in solving or at least alleviating humanity's and the planet's problems, now intertwinned in an irreducible mix, move up a previously prevalent ambient inertia. The political will may often remain quite soft, but the people act up. People are willing to change their minds. This was the central thread of this book.

What are the main ideas contained in this book? Probably that "growth-as-understood" is a misnomer. Economists say there is good growth and bad growth, and that the difference in the weight of all those uncounted externalities amounts to serious hindrances to the society, hence to the economy: polluting the environment, not maintaining a healthy human population. Discounting externalities, and their costs attached is certainly a bad thing, but the really bad thing is that we speak as if any growth was external to us beings. Until we are capable to internalize absolutely everything, first in our computations, and then in our way of thinking, there will be "externalities" left over. And the growth model will remain incomplete. After a UN adoption of the 17 Sustainability Development Growth criteria, internalizing the SDGs requires about the same work we did for "growth" in this book.

Here are the major messages from this book:

1) Capacitate growth! Taking economic growth as a prescription leads to too hard a job. Growth isn't a prescriptive issue. It's a prospective issue that requires innovators to come to the fore. Growth results from a mindset that speaks of innovating. Not so much innovation in the results themselves, such as products, services, processes, business models, etc. But more importantly in the path taken to them, which is the models, the methods and the techniques for obtaining them. And yet, the core capacity is the capacity to design such a path, which is to be able to conceive new models, methods and tools for different paths depending on the domain, the gap to obtain with the state-of-the-art, the roadmaps we strategically forge.

2) Design futures! Taking the prospective way up entails adopting a design-based approach. One reason is the sheer complexity level reached by our post-modern society in all systems and systems of systems. Past hierarchical structures gradually leave way to lateral models of organizing economy and society. Past top-down models, including simulation-based methods, more often become intractable at macro level.

3) Energize growth! The terminology we're using reflects how much we are willing to solve the "growth conundrum". To begin, replace "growth rate" by "level of growth". Sustainability is a very tough goal with a high complexity level. It has to be taken up "from within". Growth is first and foremost an energy, a movement. Before ending up in databases and statistics, it must be sourced, and the corresponding indicators will only be useful if positioned at the same upstream mark. Indicators that enable growth, not those that merely count the beans. Production and productivity are making the distinction. With the energy of growth, we collate the wills of people, entrepreneurs and all others. *Unique But United!*

4) Distribute fairly! Distribution is the core issue. Not the distribution of what already may exist be available somehow, but the distribution of anything that is created from now on. The definition of distribution methods is to be specified before the goods are made.

The method we've been using throughout this book deals with exploring the unknown.

We vow that business schools can follow the same approach for the business sphere. Our experience with some of them shows both the usefulness for business education and for future business professionals having to cope with uncertain world and lots of unknown around their business. It is both a tool and a vehicle for teaching stuff with transdisciplinary flavor.

12.2. Enhancing dynamics

This book enhances the properties of dynamic systems in the economy and offers new concepts for managing those in any field of interest. Several motives that combine themselves together back this orientation:

– pointing to right windows of opportunities fast;

– reduce an insensitiveness to situational ambiguity (uncertainty) and to complexity; and

– continuously adapting to economic environments so as to sustain a high innovation level.

Whereby traditional decision means becoming inoperative (because of being too slow, not focusing on real dynamic needs, etc.), an organization faces ever major risks that it can't monitor safely: it doesn't know what it doesn't know. The time has come to manage "energetically", through a conduct suited to evolutive environments.

In complex environments, leadership isn't the affair of single individuals any longer. It is shared collaboratively, synergetically, by adherence to a superior dynamic stake (and not static objective). Everyone generates a leadership capacity, like a swarm, a flock of birds, a "shoal of fish" in mission somewhere.

A new engineering science becomes the source of a new economy. Let's take the opportunity to experiment in order to obtain useful responses in view of the fractioning that unites and the union that divides.

This leads the author to resolutely found the design-based approach in futures studies[1]. And to choose C-K theory for its capacity to systematically explore unknown spaces with undecidable properties (this is explained in this chapter). In other terms, to be able to conceive an infinite amount (even a non-denumerable infinity) of future solutions. Only the quality and quantity of resources put in a design exercise are limiting the potential yield. The author fundamentally believes that growth fits everywhere (domain-wise) and with anything ("object"-wise). It's the method that counts first and foremost, that signifies a capacity. Less the yield that amounts to a result, a number of "beans".

Do we still want to count the beans and compare different hacks or do we wish to produce beans? The change of focus is the only way to restore harmony on this planet, which is systemically, inclusive of humans and their artifacts.

12.3. Consciousness as the molding factor?

Due to Nature's and society's continuous complexification, every basic concept tends to evolve from physics to a living being property, even up to

1 This, among other things, led him to be awarded Fellow of the World Futures Studies Federation in 2017.

psyche and consciousness. For it is consciousness that directs us to consider this or that definition of work, growth and basically any concept.

We view consciousness as the reuniting factor (the smallest multiplying factor) for all the economic terms used in this report. One root reason is that the issue of whether intrinsic limits to work and growth theoretically exist or not (hence market and GDP-like measures) can be subsumed by the possibility of having an unlimited ceiling for the sake of growth in consciousness.

The motto "Unique Yet United", which we repeat here from the Acknowledgments section, doesn't signify uniting in banality, but in the diversity among human beings instead. It is meant to express the quality that is expressed by each one. As everyone feels being part of a whole (an organization, a system, a nation, a family, etc.), each can have access to the intelligence of the whole. It is all too important to maintain all human abilities in deep activity instead of abandoning that leadership level with respect to oneself – a substitution that would deprive humans from what they are capable of themselves. "We need to stop looking for leaders and start looking for teammates" [BAR 16]. Often innovation is thought of as a substitution of a human capacity for technology. This is automation, not necessarily leading to growth: a problem to keep in mind when innovating for growth.

Innovation is a fantastic lever, an unstoppable movement. But to keep growth – and human growth with it – it is important to consider a human being in a self-transformation process of its capacities. As man abandons them systematically to external means, man regresses within itself instead of progressing: man is no longer the actor of growth.

One core aspect is the mental elasticity: if I tell you the word "Blue", what would you think? A banality probably. Yet, why would you think so: should you operate enough mental elasticity, you would be able to explore yet unknown spaces relative to this word "Blue". And you would play your own diversity among other humans. This is rooting growth. In being "Unique Yet United", you diversify according to your own qualities. It's a sort of fractal mechanism that multiplies, a movement that spins the growth world.

You will probably react by questioning this: "*how is it possible to think that a new information can operate, change and resolve something for which the level consciousness lags in some past dominant design?*" Well, not an insignificant question! But just see how networks have transformed our living and our consciousness as well.

As impalpable as the notion of consciousness may be, it is a sure factor playing systemically. It is therefore the most inclusive concept. It is only consciousness that may compel us to make an inventory of resources and assets that future generations can or should inherit. Sustainability is made from equilibria and compromises made within a process. Beyond data, information and knowledge, it requires a degree of wisdom, always superseded by consciousness.

We don't appear to be ready yet to optimally combine the social dimension, ethics in deep-rooted mechanisms for obtaining sustainable consciousness-enhanced decision-making at collective level. But we know the aim is to develop adaptive capabilities, not a system resilience that defends itself against evolution. With an intention to transmit that very openness that stimulates collaboration and alliances. Moreover, whenever a positive energy of alliance is moving, it shall unavoidably return alliance, wealth and inner growth as well as a bonus.

All resumes into an education. Not the education models dominating in these times, because they are chiefly accumulating knowledge. This anyway amounts to a paradox because smart machines are on the verge of vastly outperforming humans (individually and collectively) at chunking knowledge. The education that would regenerate growth requires building an attitude with respect to humans, to the environment, to the planet, and to the universe. Then the models get more complete, balanced and sustainability becomes a logical consequence.

After the entire above discussion, we observe that we continuously indulged in bringing factors external to an ontological human fabric: notions, concepts, artifacts, and other constructs around the notion of Growth. Fair enough for an essay we would say. Yet, there is but one fundamental ingredient which appears to be missing in humanly affairs - economics and the rest of it - and it is not inventiveness, technology, or mental capacities. All these remain only external factors, incapable to alter human conducts, attitudes and behavior. The most radical change, to not expect but

deliberately implement, lies in accepting to turn consciousness inward by looking for and finding… love.

Vice President Al Gore in his 1993 book Earth in the Balance (cited by Alexander Churchman in [CHU 71]) writes:

> "The more deeply I search for the roots of the global environmental crisis, the more I am convinced that it is an outer manifestation of an inner crisis that is, for lack of a better word, spiritual. As a politician, I know full well the special hazards of using "spiritual" to describe a problem like this one. For many, it is like one of those signs that warns a motorist. Steep Slope ~ Truckers Use Brakes. But what other word describes the collection of values and assumptions that determine our basic understanding of how we fit into the universe?"

Love hasn't been understood, is commonly assimilated to altruism or perhaps sometimes to a debilitating weakness. But it is the universal solvent to all human issues. Although the evidence was repeated over and over again throughout civilizations times by charismatic individuals, it has been neglected as perhaps too obvious or simplistic. Standard education curricula lack in the provision of accepting and nurturing love - a non percept - therefore out of scope of notional studies. The consequences are devastating: an educated humanity is bound to learn love through Promethean-like confinements with names: sophistication, division, hatred, and defense. Still, love includes before precluding, comes before everything, including mind and mental capacities, religions, and all theories and opinions.

A "quantum of solace" must be. In rather recent times, the message "All You Need Is Love" was dispatched through a planetary entertainment channel by The Beatles. That is the paradigm shift for an enhanced social system design approach which everybody may want to endorse and not await for. It wasn't then a metaphor but a new approach to distinguish the principal from the accessory. Subjugating the former to the latter has been the "human way" so far, leading to the obfuscating complexities of civilization, gradually leading to Growth bottlenecks as eminently anticipated by The Club of Rome since the seventies and reinstated later. Yet, fundamental Growth - which absolutely includes economic affairs - is unleashed by just reversing importance of the accessory and the principal, through the linking of all specificities in harmonious wholes. This in turn reorders the value base

advocated by Alexander Christakis ([CHR 05]), a dimension not clearly addressed before, even forgotten. And thus we can finally reconcile with the seminal value of the anterior and original Club of Rome Prospectus [THE 70][2].

New leaders are in need, not to preside[3] but to act as harmonizers. This entails different statutory roles and this book developed a number of models poised to approach them. Less Presidents, more Harmonizers!

The times are mature for humanity to close the circle – the big circle. The one that encompasses the whole environment: from cosmos to planet, humanity and me–us.

This is about raising awareness and, in particular, bringing biosphere consciousness up. It goes along with future developments focusing on economic, societal and environmental resilience, towards a truer sustainability development goal.

2 Says Christakis in [CHR 05] "The original conceptualization of the [Club of Rome] prospectus advocated the position that any attempt to resolving the global Problematique founded on traditional elitists, exclusionary, and disciplinary approaches is doomed to failure".

3 Etymologically from the Latin 'pre-sidere', i.e. "sitting before".

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PART 4

Appendices

Appendix 1

A Short Primer on C-K Theory

A1.1. Why use a theory?

Why use a foreign theory to discuss growth issues? This may look odd at first, and a reason was invoked in Chapter 3: the nominal capacity to explore the unknown. It also fits the design-based approach well; suited to first deconstruct the notion of growth and its related concepts. Beyond it, basing the design reasoning on a theory provides the necessary foundations to extend this work much further in the socio-economic tissue of our civilization. This can be done bottom-up with groups of professionals and decision makers in given domains and sectors, in education, in administration as well as in professional realms.

When playing it top-down, we address more prospective issues, especially foresight exercises in local governments and corporations. The notion of growth is all encompassing for humanity; it speaks of its evolutionary capacity and greatly transcends the mere quantity of goods that a specific nation or firm can churn out. Foresight planners still often use scenario-based approaches, and we believe they've become insufficient, falling short of creating solutions that reflect specific wishes and objectives. To be manageable by groups of (human) professionals, scenarios cannot come in high numbers or the projected future becomes intractable. Then, being discrete points in a vast space (which resorts to unknown situations anyway), they reveal vacuums in between, which can only be addressed by a sort of interpolation. But there isn't a good enough rationale for interpolating scenarios: they, by their very definition, don't represent the same congruence; a bit like mixing apples and pears.

Going Past Limits to Growth: A Report to the Club of Rome EU-Chapter, First Edition. Patrick Corsi.

A1.2. Beginning with a little formal introduction

Throughout this book, we provided the reasons why to choose a theory for discussing the growth issue and a design-based approach for deconstructing growth and then designing new ways to envisage growth. We had a theory available which answered both the needs exactly: the concept–knowledge (C-K) theory. This annex provides a short introduction for understanding its foundations, its basic mechanisms, by derivation of its unique power. To use it infield, a method is necessary, and we implemented the so-called design–knowledge–concepts–propositions (DKCP[1]) frame that suits the implementation necessities. At the end of this chapter, the reader will find an introduction to the DKCP methodology. Finally, a special reference section is provided to help the reader interested in pursuing this highly fruitful approach.

C-K theory from Ecole des Mines ParisTech is a powerful approach for discussing design phenomena. A direct reinterpretation of futures sciences in light of the C-K theory was performed by the trainer, whereby he argued that the latter constituted a suitable and useful asset for future scientists insofar as to imagine, design and understand, develop, manipulate and assess creative futures alternatives. He showed through multiple examples that this theory offers a systematic method for designing futures that, possibly for the first time, rests upon solid theoretical foundation.

"*C-K theory stands as a formal distinction between the space of 'Concepts' (C) and the space of 'Knowledge' (K) – a condition for design. This distinction has two key properties*:

– It identifies the oddness of 'Design' when compared to problem solving approaches.

– It distinguishes C-K theory from existing design theories, like German systematic, as C-K theory offers a precise definition of design and builds creativity within such a definition.

– It does not require the overly restrictive assumptions of General Design Theory or Universal Design Theory.

1 The DKCP implementation framework was elaborated in the period 2003–2013 by a pioneer team working on large-scale industrial contracts (among which was the RATP Paris Metro contract under the design guidance of leading prospectivist Georges Amar).

– It establishes that design reasoning is linked to a fundamental issue in [mathematical] set theory: the 'choice' axiom.

– It models the dynamics of design as a joint-expansion of a space of concepts and a space of Knowledge needing four operators C→K, K→C, C→C, K→K. They compose what can be imaged as a 'design square'. These operators capture the variety of design situations and the dynamics of innovative design."

(extracted from A. Hatchuel [HAT 03])

This formalism was found highly attractive for futures design, insofar as:

– Futures elements are conceived in the concepts space by adjoining attributes to root blueprint concepts.

– They can gain a logical status within the sharable and open knowledge space based on the past and present. Henceforth, futures that can and possibly should mobilize societies' actors and authorities. The obtaining of such logical status constitutes a highly needed evaluation of designed futures; if not, futures descriptions may be left "floating in the air".

– The theory also speaks in favor of four substantive assessment criteria in creating futures, which are value, variety, originality and robustness.

The approach sets a clear departure from e.g. brainstorming techniques or Delphi-based methods. As futures cannot be deduced solely from existing knowledge, futurists are tasked with coercing a futures creation process that should be rational, repeatable, traceable, documentable and transferable.

The approach followed helps develop new breakthrough plans, solutions and alternatives with three essential and novel benefits:

1) They help control the rationale of their developments.

2) The degree of futures innovation can be controlled (e.g. change, reform, progress, create).

3) They support policy makers in bringing a decision to the traced explanation of different design paths.

A1.3. Proposing a little, more didactic, familiarization

The innovation methodology called *C-K theory of design* is a constructive prototyping strategy for designing new objects[2] that depart from a relative state-of-the-art. It was developed by Hatchuel, Weil and later Le Masson [LEM 10] through the years 1996–2011. It differentiates from problem-solving theories [SIM 88] and establishes a formal distinction between the space of "Concepts" (C) and the space of "Knowledge" (K) as a condition for design:

– A knowledge corpus is made of propositions that are either known in some form (e.g. from theories, domains of expertise, experience and know-how, as well as emotions and feelings), or are declared as somehow feasible (e.g. prototypes), or are instead known to be impossible. Its elements always have a logical status (e.g. a four-wheel drive car).

– A concept is a proposition that is undecidable (i.e. can't be answered by a "yes" or "no"; it's impossible to decide if the proposition could be somehow actualized or not). The term belongs to general philosophy, yet always designates a specific meaning. It is close to the meaning used by engineers, designers and architects when they specify an innovative proposition (e.g. an electric car). A concept has no logical status (a flying car). A concept evokes an "unknown" proposition relative to available knowledge [HAT 03]. This differs, for example, from Bruno Latour's [LAT 05] constructivist and relational epistemology of a concept, whereby a "concept" is ontologically active and generative in a network that includes machines and humans.

How does C-K theory basically work? Here's the fundamental futures design proposition:

– In K, "matching experts" – i.e. individuals having relevant expertise or knowledge – are able to evaluate propositions with a logical status. They first mobilize the available and relevant knowledge and synthesize it.

– In C, being the space of the unknown, "crazy" concepts are progressively formulated through a mechanism of expansion (not to be confused with a genuine arborescence), as an expansion follows either a closed-list enumeration or a coherent and open amplification. Should a

2 The word "object" will be understood in a general way: a product, service, actually anything that can be subject to innovating, i.e. for altering an initial "identity".

concept be validated or verified by some mean at some point of the expansion process, it gets thrown back to the K space by definition!

This theory has been applied to a considerable number of industrial, institutional and administrative problématiques since 2003, especially with a view to design breakthrough innovations. Implementing the theory on concrete cases however requires more thorough understanding. Please see the References section for further reading.

A1.4. Acquainting with the mathematical foundations of C-K theory

This section aims to provide a few hints to the reader more interested in the formalisms underpinning the C-K theory.

A1.4.1. *On structuring the C space*

First, the structures equipping the two fundamental working spaces deserve attention. The C space is a space of conceptual "objects", elements of an infinite set, and therefore C resorts to set theory in mathematics.

The properties of the tree structures developed in the C space are embroiled with the fascination of dreamy concepts. To reflect a required undecidability, they should be desirable, open, even crazy. We here stand right at the furnace of creation! What mathematical model can represent the logic of creation?

Of course these are infinite sets, yet with a specific property that allows one to "pick" an element in these infinite baskets. In mathematical terms, it says we use the Zermelo–Frankel axiomatic by refuting the choice axiom. The reader familiarized with formal mathematics may remember that the choice axiom expresses that, "given any collection of mutually disjoint nonempty sets, it is possible to assemble a new set–a transversal or choice set–containing exactly one element from each member of the given collection" (cit. Stanford Encyclopedia of Philosophy, https://plato.stanford.edu/entries/axiom-choice/).

At the formal level, it is important to refute this axiom upfront because otherwise it remains formally impossible to pick elements.

The Mines ParisTech team who designed C-K theory proved in 2015 that C-K theory (therefore equipped with the axiomatic set theory) is equivalent to the forcing theory developed by Paul Cohen in 1963[3], for creating new objects carrying unexpected properties, that is an "artificial" element constructed from an infinite starting set and which isn't found in the original set!

A1.4.2. *On structuring the K space*

Concerning the structure underpinning the K space in C-K theory, the situation is trickier. The real question is this one:

How to model knowledge in order, especially in view of granting a fuller expansion in the C space?

Because the generative power in C necessarily depends on the way we express the knowledge chunks: to express concepts in C, we are left with the use of words only, which necessarily have correspondences in K: any concept is said to be K-relative.

To create something (i.e. in C), there must evidently be holes in the K space: we call it the splitting condition. No hole, no creation possible. Hence the importance of breaking dominant designs and other K chunks.

Coming back to the economy, economists have structured the economic knowledge space in their own way: principles, equations and models explaining how demand and offer operate, etc. This is one way to organize the knowledge available about entrepreneurs, producers, consumers and third parties. It's a modus operandi for organizing the economic life on the planet.

In C-K theory, the K space refers to category theory, a theory that disrupts the elemental vision of objects by enhancing relations. Instead of having A and B (a supplier and a consumer), it considers the relation between A and B. In category theory, absolutely everything is a relation (a morphism in mathematical terms), and objects have no existence. We view K as a space of available resources from which to "derive" elemental objects in C.

3 This led Cohen to be awarded the Fields Medal in 1966.

Going from K space to C space is an individuation process (in the sense of Carl Jung [JUN]), and C-K theory calls it a disjunction. Conversely, going back from C space to K space is called a conjunction and resorts to new relations in K. We stress that a K chunk only exists through its relations. Performing a conjunction is equivalent to positioning a newly found object in C within its ambient surroundings.

A1.4.3. *C and K dynamically reunited*

A design theory, C-K bridges set theory and category theory. A very recent development from Mines ParisTech shows that the highly abstract mathematical notion of topos is able to fuse the two spatial representations of objects in a rich, flexible and recombinable way that has high generative power.

This is the ultimate representational level we would seek to express growth and its related notions. It could build a coherent society while growth becomes an all-encompassing determinant, resonating with everything humans do, say and think. We believe that – however very abstract – topos are the solvent tools to describe and use the structural components of a future society: open, rich, ever recombinable into new settings.

At this stage, we are quite far from the hierarchical structures of the 20th Century. This reveals a cultural and a cognitive paradigmatic shift. At the educational level for instance, we would induce students to describe their economic world not by listing, say suppliers, competitors, and the rest of it including stakeholders of an ecosystem. By learning to describe worlds by not at first individuating, but by implementing these guidelines:

– relationing objects;

– enriching descriptions;

– using various description levels;

– being systematic.

Students would rather not say "*this is a debt*", but instead express that "*a debt is a (contracted) relation referring to… that… due to… forced by… alterable by… etc.*", thus always expressing as a system of relations which

interoperate. And then represent it in various illustrative ways, for example, in textual, graphical, algebraic, geometric, artistic etc. forms. All this may sound like little steps, yet supports a true ongoing revolution in the thinking and then the making when developing. Practicing topos in dedicated fields of human achievement is the way to the open futures.

A1.5. Introducing the DKCP implementation framework

The DKCP approach was born out of necessity from the pressures observed in the industry:

– data mining and information collecting topping industry's priorities;

– competitive pressure eroding the value of any good – product, service, process or model;

– corporate R&D falling short of ensuring the renewal of an organization's competitiveness;

– traditional creativity and problem-solving techniques becoming unadapted for securing breakthroughs;

– innovation being forced to become intensive and repetitious – therefore a continuous process.

The DKCP process methodology enabled industries to focus on the development of new products and services with high added value and is founded on over a dozen years of practice. It made them obtain new competences that regenerated their competitiveness on new strategic market spaces. It was forged in symbiosis with industry as an implementable mean to field the C-K design innovation theory developed at Mines ParisTech, which was outstandingly awarded by the World Design Society in 2009. For years, an industrial chair has been managed by the C-K theory research team, which gathers a whole ecosystem of industrial players and academic resources.

DKCP unrolls four phases, which may slightly overlap:

– D Phase: it scopes the initial issues and establishes the problematics at hand, as well as its stakes, with a view to seek breakthrough innovations. The resulting formulation can't be tackled by classical methods and techniques,

as it is formally "undecidable" (can't prove it's true nor false). It is that very property that authorizes an innovative process.

– K Phase: collectively mobilizing and sharing the knowledge elements relevant to the undecidable proposition above leads to a necessary mutualizing among domain experts and the professionals of a given economic ecosystem. The technical and economical states-of-the-art are confronted with the limit conditions. This phase founds the common grounds on which to perform the subsequent phases. The initial undecidable concept can be refined and/or varied in light of this phase.

– C Phase: here a thorough conceptual expansion of one or more formulations of the initial undecidable proposition is conducted. The exploration into the unknown goes on systematically – along with the mobilizing of existing or lacking knowledge – until realistic propositions are found in the form of advanced, "second generation" concepts.

– P Phase: collecting the latter plausible, perhaps feasible, concepts is the first focus of this phase, which is worked by inductive (or sometimes abductive) synthesis, a recombining of the fragments obtained. A step that leads to proposing and delineating project propositions for the management of the target organization with a view to align them with its strategy, often in the form of a time-staged plan from short-term to longer-term horizons. Action plans can be deceived and innovative projects launched with a finer resolution of the required resources and other means, thus delimiting the costs of R&D, accelerating the obtention of quick wins and prototypes, all by mobilizing the target ecosystems with better precision.

A1.6. Further reading

The following structured list is intended as useful guidance for investigation and is by no means exhaustive.

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Appendix 2

Some Chronological Reports to The Club of Rome Commented

The Club of Rome

The Club of Rome is a global think tank. Members are notable scientists, economists, businessmen, high level civil servants and former heads of state from around the world who share a common concern for the future of humanity. The Club of Rome's mission is to promote understanding of the global challenges facing humanity and to propose solutions through scientific analysis, communication and advocacy. Recognizing the interconnectedness of today's global challenges, the Club of Rome's distinct perspective is holistic, systemic and long-term. It has National Association in 33 countries and is supported by a Secretariat located in Winterthur, Switzerland. The Club of Rome conducts research and hosts debates, conferences, lectures, high-level meetings and events.

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G, I, J

K, L, M

N, O, P

R, S, T

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