1

Disassembling Some Traditional Views

1.1. Time and space: past, present and future

In playing with relativity theory, we end up abandoning time as an absolute reference. Does time exist in nature? Is time necessary to describe our behavior and events? And is time a continuous variable? Coincidentally, is space limited either in a small-scale or large-scale universe?

Under these conditions, what is the impact of a "time and space" concept on our current operations, such as planning, scheduling, sequencing, organizing and way of thinking? Concerning the sustainability of an enterprise, particularly in economy, what confidence level can we attach to a statement such as *too big to fail*?

We are, indeed, faced with a scale issue both in time and space: in big organizations, decision makers think that global structures are quite stable. Indeed, we can distinguish the structures of the organisms, with regard to the complexity of their assembly, into four categories: micro, meso, macro, chrono (in a simplified way). The higher the level of the assembly (it is the case in cosmos or cosmic structures), the more stable the system appears: a large structure seems to be more stable than a small one. By contrast, due to the huge amount of the interconnections, the larger assembly remains SIC (Sensitivity to Initial Condition) and could be highly sensitive to the action of individual elements. In industry, for instance, the entreprise (a macro system) will be sensitive to small disturbances like individualism or to the financial aspirations of those who are responsible. Similarly, a human being (meso sytem) will be subject to illness brought by a bacteria (micro system), etc. Additionally, the intrusiveness of governments in large enterprises can be considered as an approach to *global* governance. Still, is there any difference between aiding a company, regulating a banking system, controlling a nuclear power plant and managing a pool of companies or a galaxy? Are major economic or political problems replicating the laws of nature? Are cybernetic systems able to adapt or regenerate themselves as happens with micro-organisms?

In business spheres, decision power is quite often concentrated in huge decision nodes. Are these able to handle very large volumes of information and decide as networks do? In a nutshell, what is the right balance focus between concentration and swarming?

To summarize the concepts developed in this chapter, we will recall the present situation that humanity is faced with:

– humanity has gained some ability in understanding some parts of its own ecosystem and own sown feelings about what are the expectations and intents of a society;

– we humans are living in a global world and population evolves quite fast, according to simple common rules and basic constants;

– introducing quantitative concepts (based on numbers or measurable parameters and variables) is of great importance since, in nature, we are heading all together to the same biosphere: this requires qualitative and quantitative modeling, but it is quite difficult to reason and compute it on fuzzy and unprecise data. This is a new fact, particularly important with Big Data;

– going back to physics generates new paradigms; it alters and enables the considering of our relationship to all things, our ways of thinking and performing well in organizations, including industry;

– in critical situations, like bankruptcies, or disruptive changes in industry, everybody knows that issues of organization and structure primarily predominate;

– under these above conditions, the question is: what is our future and how can we prepare and cope with it in practice?

In addition to these “time and space” considerations, we have to challenge our approaches against the five “codes” as defined in the introduction of this book. For instance, entropy will be introduced in the theory of organizations, and the entropy of our organizations and living organisms may evolve over time and may also increase holistically. At the local human being level, this is, however, not a necessarily irreversible concept. Thus, questions could be how to improve the sustainability of a system, how can we reduce its entropy, etc., without denying scientific advances.

1.2. The (big) law of correspondence

The evolution of matter in the universe integrates more and more complexity over time. Figure 1.1 shows the size variation of the universe according to age. We can identify several seemingly independent and autonomous levels generally considered and described from the infinitely small up to the infinitely large.

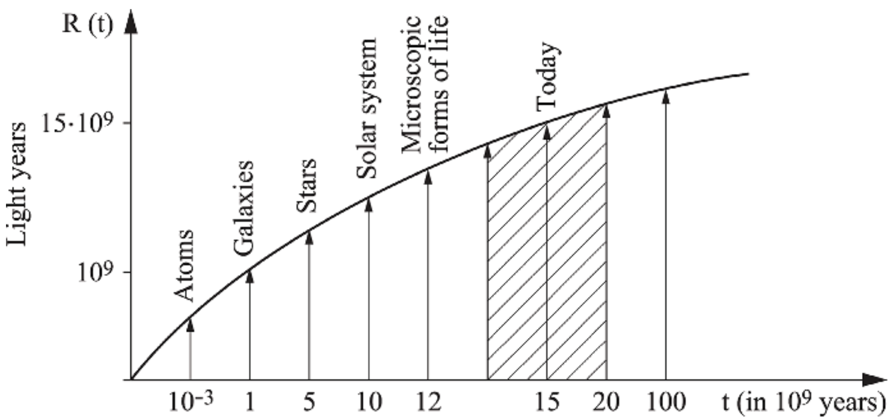

Figure 1.1. *The size variation of the universe according to its elderly [MAI 96]*

If we now take a look at the so-called "forms of life" included in the graph, we can explode it again as follows (Figure 1.2 from [LOB 08]).

By reading from left to right, we can quote [LOB 08]: "Many different kinds of macromolecules are used to build cells, which in turn are organized into tissues. Tissues form organs, and several organs may have interrelated functions in a cohesive organ system, such as the digestive system. A complex organism contains multiple organ systems with different functions. Multiple organisms of a single species may form a group, called a population. Many populations of different species form diverse communities, and communities that share the same geographical space are part of a larger ecosystem. The Earth's biosphere is made up of many diverse ecosystems".

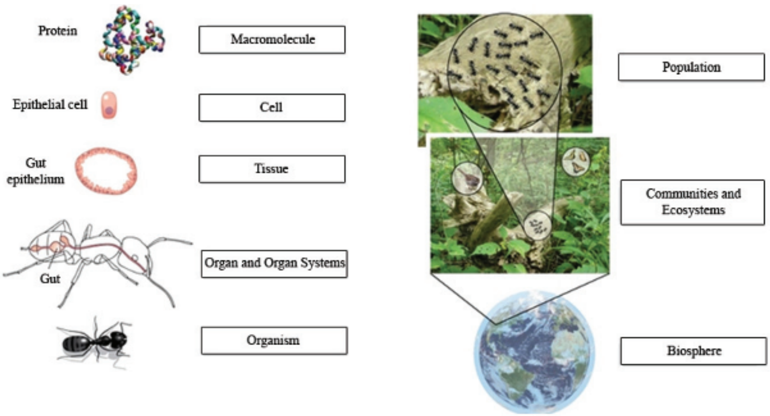

Figure 1.2. *The evolution from matter to thought: a complexification process*

The description of such an assembly is of great importance: the resolution of possible problems at a given level and upper level of assembly (for instance, in a live being such as an ant or a human, an assembly of different organs interacting together) depends on the organizations and structures elaborated at its previous lower level. The consequences of actions and evolutions at a lower level (or subassembly level) are always impacting the organizations at a higher level (i.e. the population). As a result, we can never ignore the laws of interlevel correspondences.

As aforementioned, we provide some details through specific examples below.

We are always learning by observing and imitating what surrounds us: we look at the nature and observe how changes are conducted; we discover new technologies, discover their capabilities and transpose them, after some improvements or adaptation, from one area to another. Also, we are establishing profitable relationships between interrelated areas (biology, social sciences, anthropology, etc.). It is of great importance to better understand the underlying mechanisms existing in nature, to then improve and finally enhance the basic principles of human actions.

However, any discovery made either at the infinitely small or infinitely large scales cannot be ignored because our own mechanisms as live beings are positioned between these two extreme dimensions. For this reason, meta-modeling is always necessary to generate new products and processes. "*What is above is like what is below*": conventional modeling is there to better understand and explain what is going on. However, several variations of such modeling will be used, and we can state the following:

– cross-cutting levels of representation are required to focus on interactions;

– usage of one-level method to represent, understand and solve other levels problems must be generalized and "go beyond reasoning by analogy";

– three-dimensional (3D) globalization is an old and common idea, useful to improve our vision of some phenomena. This approach is mainly based on space modeling; however, it is limited. Globalization requires us to go further with the introduction of additional dimensions (time, space, entropy, scale, living or inert matter, etc.). This is introducing levels of organizations requiring trans-structural expertises in order to establish some consistency between macro-/meso-/microlinkages and anticipate the properties that can emerge at an upper level.

When we quote "globalization against scale", we also envision paradigm changes based on either quantum physics or cosmology. In terms of associated technologies useful to represent some phenomena, some use string theory (with its 11 dimensions). This recent theory was elaborated by some scientists to validate a particular concept: *a grand unified theory*. Even though the theory is too complicated to enable a wide distribution of its advanced concepts, we can adapt its underlying meaning and principles to explain how and why we can proceed in the real world (clustering, ontologies in knowledge, identification of global numbers, inductions, etc.).

Nevertheless, our universe is still limited either backwards (what we observe is already linked to the creation of matter; what we see is associated with light emission, i.e. after the 380 K years) or forwards (we are also helpless in the face of the infinitely large dimension). For instance, before the fluctuations of matter and quantum gravity, everything is speculation. About the universe, to make it happen, we need to have time fluctuations before the Planck's time; under these conditions, it is possible to show that the number of dimensions will be reduced given that the more our knowledge on basic theories is increased, the more our understanding is able to simplify a reality. It is exactly what happens when we try to identify and define the very first fundamental cause of an event or a problem in a system: it a condition for a better sustainability.

Should we be interested in comparisons, we can quote Google: presently, scientific discoveries are increasingly issued as inspired by Google software products. Typically, these are able to process huge volumes of data, to identify lots of links and to highlight relevant relationships. This so-called "*Big Data revolution*" is similar to that observed in fundamental physics: search is based on the emergence of a new paradigm (or concept) from large databases. A specific emergence will be the result of an unexpected, undefinable or intangible germ.

Here, contrary to what is happening in conventional industrial approaches, we do not need techniques such as "statistical correlation" to validate an assumption since emergence is the result of a self-organization process. It is also the same principles that we observe when studying astronomy (global analysis of galaxies moves – large synoptic survey telescope (LSST) project), language organizations and word structure (Deb Roy project), and emergence of physical equations from large volumes of data (Eurega project from Cornell University).

What is said through these examples is relevant to observations (and not only to speculations) about the concept of "information" and self-organization. In our real world, information consists of defining the relationships and interactions between the past and the future of an event. Many people think that business analytics approaches are key for solving such challenges. Unfortunately, these technologies are deductive, i.e. they enable us to describe, interpret, synthesize, correlate and segment (clustering), classify and order, but not anticipate or create new information.

In contrast, inductive and abductive processes enable us to determine the structure, organization, processes and operating procedures in a system from a huge volume of data. Also, new knowledge – and matter as well (i.e. a structured organization of energy, at low temperature) – emerge from information. Thus, in the same way, a quite logical speculation consists of deducing that before Planck's time, everything is started due to *information* (be they codes or numbers, or initial physical laws or mechanisms) and that all of our universe will also end with information (Turing machine [GIR 95]).

If we consider our universe as an open system, everything is information that comprises the knowledge, know-how, intellectual legacy and inheritances, etc., coming from our world or universe toward other universes: we are evolving in a quite imaginary assumption. Yet, if we consider a lower level of complexity (for instance, our Earth), we are still in an open world or system, within our universe, but starting at the "beginning time" of the Earth, ending as soon the "after-earth" era is started.

A similar situation is faced when a civilization disappears: there is always information related to technology advances, societal and cultural assets. Such information is transferred to the following civilizations. This is the way the entropy of information is growing.

Again, this is what happens on the Earth with DNA. DNA is information: it is a coded string of chemical bases able to generate proteins, etc. Through gene sequencing, we are able to specify and describe the diversity of each species, and thereby their underpinning mechanisms and characteristics, the cause–effect relationships related to different diseases, activation and implication of specific genes in life evolution, etc.

Every 10 million years or so, when cataclysms destroy most species, new kinds of life take place on the Earth based on new organizations and environment, but integrating either some assets already acquired, or new emerging capabilities coming from some potentialities.

It is a common fact within any living being that DNA (an information program) continues its evolution and perhaps, when applicable, may transfer this essential information/knowledge to some other worlds and levels of organization/organisms. Therefore, one unavoidable question is: what is the DNA of an enterprise? How to specify it?

Finally, to return to the concept of "time": it is a construct useful for human beings to represent some phenomena, measure a duration or define a chronology. However, this concept has also evolved: in effect, at the microscale level, the unit time is shorter than it is at the macroscale level. Moreover, at nanoscale level, time is reversible (with regard to quantum physics), whereas at our level it is not, except for very specific cases (e.g. physical models evolving slowly and reversible mathematical models). Consequently, *time* is a relative concept. In other words, as we will see later in this book, time is not a mandatory variable in physics and industry; we can work without it. For instance, to describe the cyclic trajectory of the moon, we can rely on the fact that, according to a given position of the stars and moon (that is a so-called configuration), there is a specific observed phenomenon or property; as common agricultural sense says: when the moon goes down we are planting radishes, while, when the moon rises, pea seeds should be buried.

Whatever the perspective considered, we see the need to focus on integrating several concepts: the various notions of "codes", the information society, the contexts of globalization and complexity, among others. These are global challenges; only the implementation of *global* sustainability will reduce the uncertainties and the difficulties provided by a breakdown in the evolution of new theories and sciences.

1.3. Intricate imbrications and their uncertainties

Everything in nature starts with a stack of assemblies. For instance, if we consider what happens down from matter up to living organisms, we can highlight this very interesting graph developed by physicist John Wikswo in Robotics and Biology at Vanderbilt University. He developed it using multiple computers to collaborate and communicate. It is typical of a coevolution mechanism.

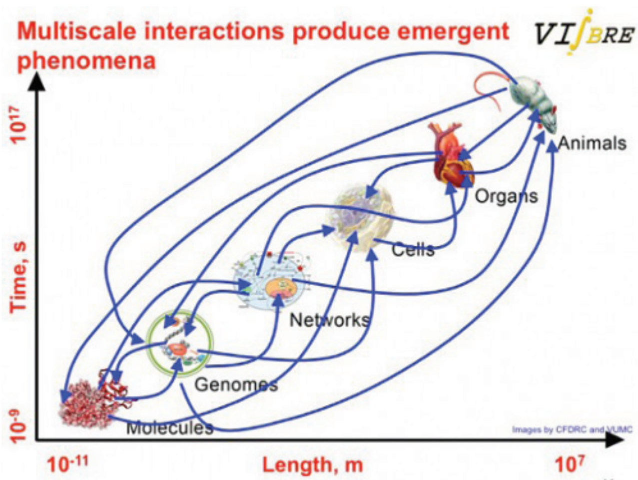

Figure 1.3. *Interaction existing between the different levels of a stack (courtesy of Wikswo Lab)*

The complexity of such a biological model arises from the fact that we merge infinitely small elements with infinitely large assemblies, and we operate assemblies whose takt times range from a billionth of a second to billions of seconds.

According to Wikswo, the crowning source of complication is that processes at all these different scales interact with each other: "*these multi-scale interactions produce emergent phenomena, including life and consciousness*".

Indeed, if we consider the last step called "animals", it could be divided again into several substeps:

– level 1: cells and bacteria;

– level 2: living mechanisms, brain and consciousness;

– level 3: population and society;

– level 4: information system generation;

– level 5: universal and advanced "communication" domain (mind-to-mind);

– level 6: holographic and other key quantic models.

There is no limit to the number of levels in stacks which are elaborated by mother nature. The system's sustainability is then becoming a challenge: as soon we consider a global and a system-based approach, we cannot integrate too many detailed structures, as this generates unmanageable sets and models.

Today, we are still in a precompetitive phase and are just developing the foundations of a future science by handling the basics; we have developed theories to explain some phenomena satisfactorily, yet are not certain that these theories will not be challenged in the future. Their purpose is to enable innovation and offer new products and services that facilitate the comfort and life of humans, by multiplying also its capabilities and sustainability of the whole.

1.4. Many levels: subatomic, micro, meso, macro, chrono, etc.

In Figure 1.3, due to the numerous observed interactions, the model is not hierarchical. It is impossible to deduce the behavior at mesoscopic level from what is happening at microlevel. Moreover, it is impossible to predict what will happen at macroscopic level from information and status observed at mesoscopic level.

In next chapter, we will see in more detail why such systems are unpredictable and why anticipation is quite impossible, if only for computational reasons.

This relativity of scales is common to all fields (biology, industry, astronomy, etc.). Wanting to address the problem of sustainability through biased and simplistic aspects is meaningless: in any public or private organization, the policy making or the claiming of a settlement of an issue through engagement in dead ends often cannot be so simple.