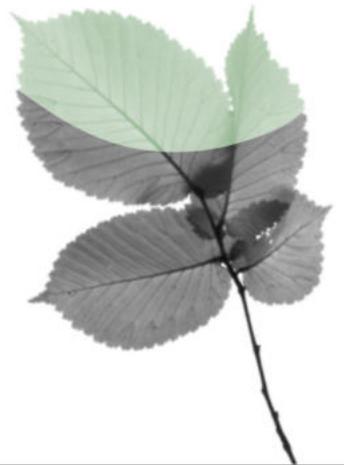
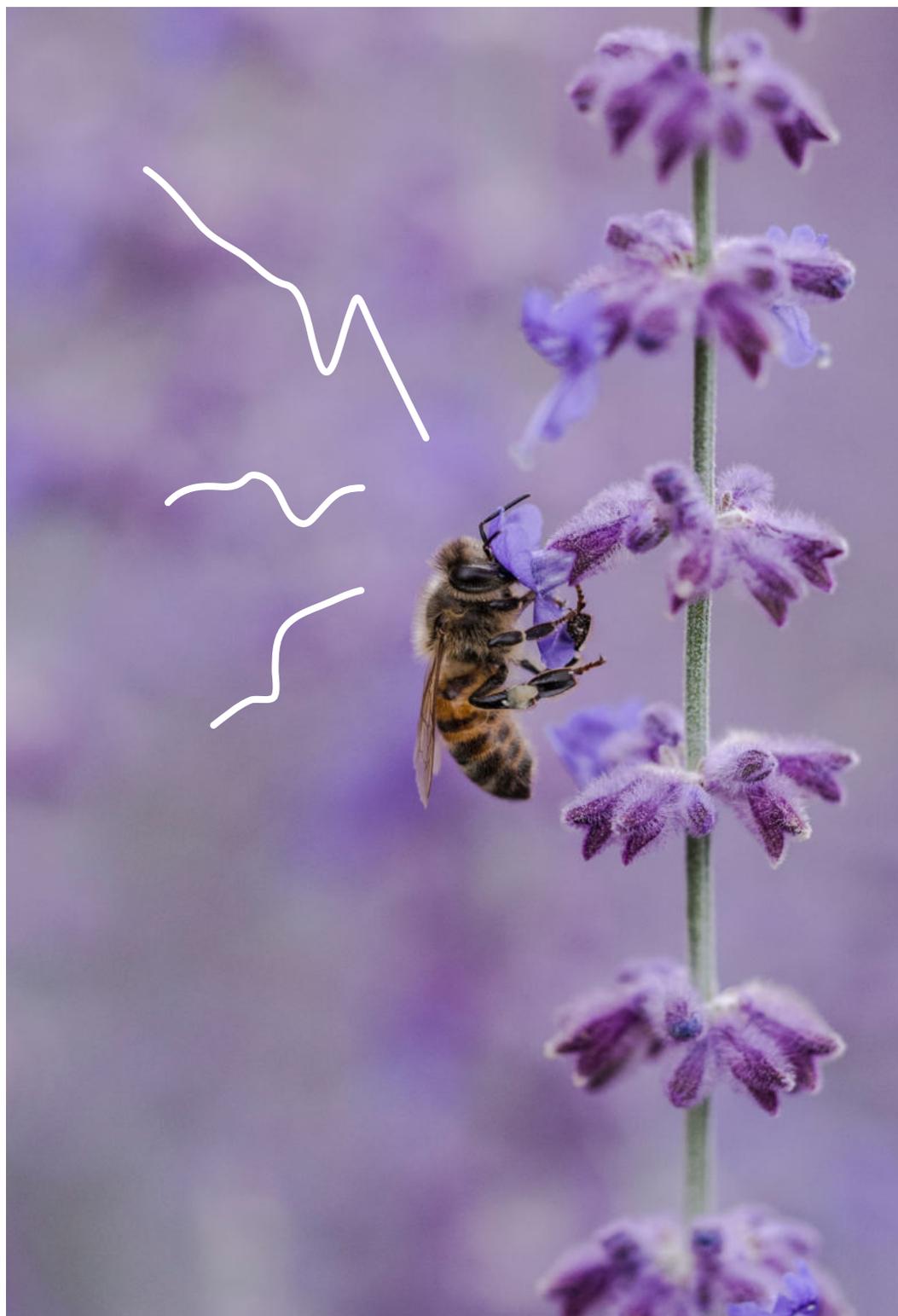




DISCOVERING BIO-INSPIRED STRATEGIES





This document helps you understand how living work. We have chosen to keep only the **18 most appropriate principles of living organisms**.

These have been grouped into 4 categories: **collective strategies, construction strategies, temporal strategies and resilience strategies**. These strategies, which are sometimes contradictory, are historically inscribed in a variety of natural contexts: constrained or, on the contrary, opulent resources, extreme conditions or mass extinctions than to apply these guidelines to any to any new mandatory process.

CONSUMPTION *strategies*

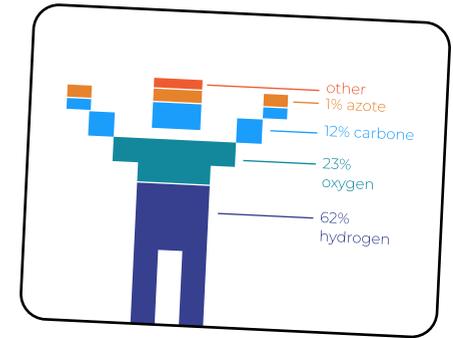
The living world benefits from the availability of local materials and energies for its functioning. It assembles simple elements into complex structures, which it then recycles.

Construction strategies

Using resources sustainably

Living organisms use the most abundant resources (CO₂, O₂, etc.) and very marginally rare resources. The use of abundant materials avoids dependence on a limited resource.

#Abundance
#Sobriety
#Frugality



on the living side

Let's look at the atomic composition of the human body: 62% hydrogen, 23% oxygen, 12% carbon, 1% nitrogen, traces of calcium, phosphorus, potassium, sodium and so on. But what are the most abundant elements in the universe? Hydrogen, helium, oxygen and carbon top the list! So we're made up of the most abundant elements in the universe, just like all living things.

organizations

Did you know that from the 16th to the 20th century, farmers in England and the Netherlands were able to grow fruit and vegetables that were nonetheless Mediterranean, thanks solely to the use of renewable energies? The installation of a fruit wall (a simple south-facing wall that retains heat) creates a microclimate at its base, making it possible to grow Mediterranean fruit varieties in temperate climates such as northern France, England and the Netherlands. In the meantime, we have invented heated glass greenhouses, which consume 10 to 20 times more energy than open-ground cultivation.

Recycling all raw materials

Waste from one organism becomes a resource for another. Living organisms use the most abundant atoms, facilitating the circularity of life. Note that in "Nature" the notion of waste does not exist, it is purely anthropic.



#trial and error
#experimentation
#evolution

Construction using elementary components

It's by starting to build simple elements in limited numbers that living organisms form more complex elements. Living organisms are built by successive additions of interlocking systems (cells -> organs -> individuals -> populations -> ecosystems -> Earth).



#elementary-bricks
#emergence

on the living side

Once fallen, tree leaves become both a waste product and a resource, turning into tannin, a highly prized food for mushrooms.

At the dawn of life: Bacteria appeared, capable of using sunlight as a source of energy - photosynthesis. As these bacteria grew, they mass-produced O₂, the waste product of photosynthesis. At the time, this toxic and ever-present waste threatened to eradicate all forms of life. Life adapted: micro-organisms became capable of using oxygen as a resource. Recycling and the circular economy have turned the threat into an advantage.

organizations

The circular economy is a strong embodiment of this principle, and offers many examples:

Cabinetmaker Franck Grossel reuses waste from beer brewing: spent grains. And these spent grains become the raw material for his stools!

Les Chaussettes Orphelines recycle your socks with holes in them... to make new ones! But even before recycling, let's think about reducing and reusing. It's the famous 3R rule: Reduce first, if impossible Reuse what exists, otherwise Recycle.

on the living side

Every living organism is based on information encoded in what is known as DNA (deoxyribonucleic acid). Made up of 4 basic building blocks (adenine (A), cytosine (C), guanine (G) and thymine (T)), DNA "codes" living organisms in all their inter- and intra-species diversity. We can therefore say that living organisms need only 4 elementary letters to write a novel with an incalculable number of characters over 4 billion years!

organizations

Today, we are witnessing a genuine revival of interest in the use of local materials in architecture. Stone, certain types of rock wood and bricks are widely used in the design of new buildings.

The advantages of this vernacular architecture are numerous: reduced ecological impact, relative abundance, lower transport costs!

COLLECTIVE *strategies*

Species are interdependent. Thanks to ongoing collective exchanges, living organisms can achieve high levels of robustness and resistance to change.

Collective strategies

Divide the work, specialize

#subsidiarity
#expertise

Some species have become particularly specialized to their ecosystem and environment, in order to adapt and survive. This specialization is the result of many years of evolutionary adaptation: we even talk about co-evolution.



on the living side

Birds' beaks are particularly well adapted to their consumption habits. For example, the hummingbird's beak enables it to fetch nectar from flowers, which is inaccessible to other species. Some plants have co-evolved with the hummingbird, modifying the shape of their flowers to make them more accessible to birds, enabling them to be pollinated. This principle is double-edged. In nature, depending on environmental conditions and their evolution, specialization can be an advantage or a disadvantage. For example, alpine species that are highly specialized to survive the cold are now suffering from climate change.

organizations

This principle illustrates the division of labor from a technical and international point of view. Philosopher and economist Adam Smith explains that specialization generates wealth through indirect profit. This brings us back to the industrial method of work organization (OST): Taylorism. It is based on the productivist principle of division of labor. While this method democratized access to consumer goods through mass production, it also had a considerable impact on worker motivation and working conditions.

Closed but open to the outside

Every cell, organism and society needs to be closed to ensure internal functioning that would otherwise be impossible. But these same cells, organisms and societies must be open to receive energy, information and matter!



#watch
#interaction
#flux

on the living side

Every living being is both closed (an entity dissociable from its external environment) and open (it receives external energy to maintain its metabolism). Every living being is both closed (it is an entity dissociable from its external environment) and open (it receives external energy to maintain its metabolism). In the human body, the skin embodies this interface with the outside world: both closed because it protects (shocks, pollution, UV rays, microbes...) and open (which is necessary for thermal exchanges to regulate body temperature, but also for bacterial exchanges to stimulate the body's immune defenses).

organizations

A company is a perfect illustration of this concept. It is, of course, open to the outside world, where it finds its raw materials, energy, human resources, customers and so on. But it is also a concept defined by borders: legal, geographical, social, symbolic and even service.

Decentralize

In nature, there is no centralizing body: on the contrary, all information is decentralized: each individual has the minimum information necessary and communicates with his or her neighbors through dense networks.



#holocracy
#horizontality
#interactions

on the living side

A termite mound is an earthen structure several meters high, consisting of galleries and a heat regulation system that is conducive to termite life and provides numerous ecosystem services. These entities are built without architects: only the action and interaction of the insects result in significant levels of complexity and functionality.

organizations

Urban planner Carlos Moreno has developed the concept of the quarter-hour city. A city model based on proximity, where residents would have access to all essential services (shopping, work, entertainment, culture, sports, healthcare) within a maximum 15-minute walk of their homes. A decentralization of services that would transform local life for city dwellers.



Share information and synchronize

All living systems have the remarkable ability to synchronize and transmit information in order to develop, repair or self-organize. And this applies to both organisms (e.g. trees) and ecosystems (e.g. forests)!



#multiple exchanges #self-organization

Cultivating cooperation in crisis situations

The principle is simple: the focus is on the group, not the individual. This cooperation can go as far as the common denominator, while symbiosis is the source of better survival strategies in the event of a crisis.



#care #interdependence #coopetition

on the living side

A scout bee informs foragers of food sources. It dances to indicate the direction and distance of flowers. The flower itself, with its colors and scents, provides information to attract pollinators.

Wood wide web (the internet of the undergrowth) is a network whose function is to link the trees of a forest, thanks to the thousands of kilometers of micro-connections woven between them. This network, developed by fungi, facilitates the coordinated exchange of information and nutrients required for development and adaptation.

organizations

Decentralization manifests itself in new modes of governance and managerial models within organizations.

This is the case at Onepoint, where each employee chooses the projects he or she wants to work on personally. They then surround themselves with the competent people they need.

This horizontal system encourages employees to get in touch with each other to learn about and share their projects and skills.

on the living side

To combat the cold, penguins gather together to keep warm, taking turns on the colder extremities.

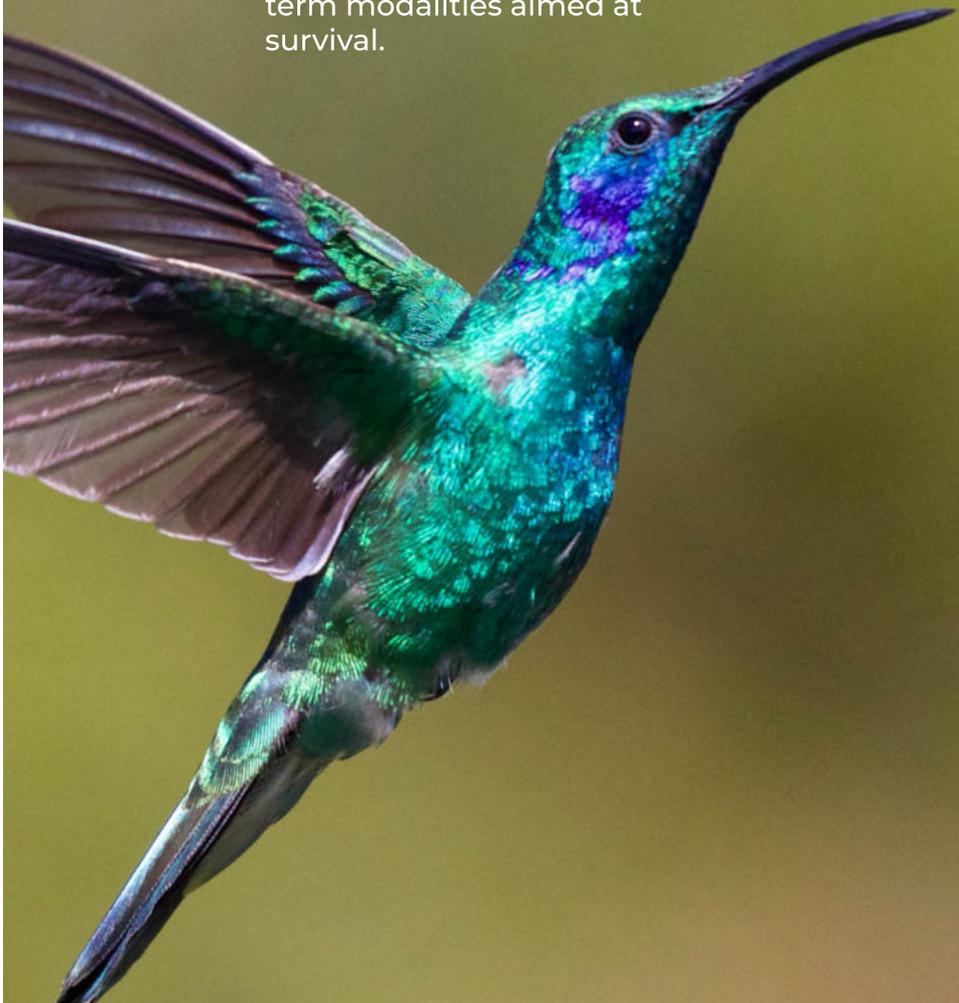
The matsutake, also known as "the mushroom of the end of the world", grows in the most hostile environments, based on collaborative survival (after Hiroshima in particular). Its roots intermingle with those of trees, which supply it with carbon hydroxide. In exchange, the fungus provides the water and nutrients the tree needs to thrive. The matsutake is never alone, growing only in inter-species collaboration.

organizations

Emmanuelle Joseph-Dailly, bio-inspired business consultant, talks about "coopetition", a neologism derived from the contraction of the terms "cooperation" and "competition". Coopetition refers to "collaborative competition", as exemplified, for example, by Cape Gannets and dolphins competing for sardines. Integrated into organizations, this principle changes the way we look at competitors, from an offensive strategy to a more effective and efficient alliance strategy.

TEMPORAL strategies

The living world is the culmination of 4 billion years of continuous functioning and adaptation. Observing these evolutions is an opportunity for our organizations to take advantage of cyclical short-term adaptation strategies or long-term modalities aimed at survival.



Time strategies

Designing as cyclical processes

In keeping with the circular organization of resources, most natural processes are cyclical (days / seasons / glacial cycles / tides). Living organisms are subject to this in their metabolisms, which are themselves adapted over the course of evolution to external cyclical processes.

#integration
#programming



on the living side

Living organisms do not benefit from cyclical processes, but are subject to them. Evolution means that it adapts to cycles that are external to it. For example, the sunflower follows the path of the sun to capture as much energy as possible, but without any intention to do so.

Some zooplankton and jellyfish migrate vertically every night to feed more safely. Light also influences human production of certain hormones, such as the famous melatonin.



organizations

Our organizations have largely freed themselves from natural cycles: working 3 shifts means that companies no longer stop at night, our days follow the same rhythm, whatever the season... the weather no longer influences more than a tiny fraction of our activities.

However, this liberation also entails risks: chronic fatigue, depression, burn-out, loss of meaning, and so on. What if reconnecting with natural rhythms - and therefore considering sub-optimization - enabled us to live better, and ultimately optimize our well-being?

Ecosystem services

#long time
#interdependence

In ecosystems, interactions between species and their environment generate a range of "services" useful to all: these are known as ecosystem services. Generated gracefully, these are useful to other species and even to the ecosystem as a whole.



on the living side

The earthworm is essential to the soil. By digging galleries, earthworms aerate and enrich the soil. They also play an essential role in transforming inert organic matter into mineral elements usable by plants. Two great services rendered without the worm even realizing it!

Through their root network, fungi stabilize and structure soils, preventing erosion. They also provide trees with mineral salts and residual water in the event of drought. In exchange, the trees provide sugars. Mycelia connect roots and trees to one another and promote exchanges.

Under-optimize

#long time
#interdependence

By naturally operating in an under-regulated or non-reactive mode, the body leaves itself room to maneuver, adapting to constraints and mobilizing its full potential when necessary.



on the living side

The body's proteins and enzymes are sub-optimized (37°C) to anticipate a punctual optimum during crises (39°C 40°C). These margins for maneuver are adaptation resources.

In anthills, 20% to 30% of ants do... nothing at all. And yes, they are the anticipated reserve for potential crises.

organizations

Buurtzorg (neighborhood care) is an innovative model for home care. The company has put the patient back at the heart of the care system by investing the necessary time in each patient. An approach that challenges the logic of productivity! However, this approach has resulted in greater patient autonomy and satisfaction, fewer emergency room admissions and a greater sense of responsibility among staff, with a view to long-term benefits and time savings for care assistants.

Self-repair

#evaluation

Life's preventive strategies don't always protect against problematic consequences. It is then necessary to repair oneself without depending on an external agent. This is as true for a cut on our skin as it is for the torn bark of a tree.



🌿 on the living side

Hevea latex contains capsules in its bark that break on contact with air when the tree is damaged. These capsules release hevein, which naturally repairs the bark thanks to its coagulant properties.

Self-repair is a well-known principle in most living systems, whether for organic parts (bark or skin) or mineral parts (bone). Nevertheless, this phenomenon is generally costly to the animal or plant (it generates oxidative stress, and can compromise growth, reproduction and immune system efficiency).

🏢 organizations

Few everyday objects have the ability to repair themselves. Could you find one?

The reparability index recently became mandatory for electrical and electronic products. Its aim is to encourage producers to design more durable objects. It's a first step towards circularity in our production chains!



Maintaining integrity in renewal

#replication
#maintenance

It is necessary to pass on failing components from one generation to the next, or to renew them on a regular basis. At the same time, identity and fundamental functions are preserved. This balance between stability and regeneration is at the heart of the living cycle.



🌿 on the living side

All the cells in the human body renew themselves very quickly, yet their functions remain assured! For example, the cells of the intestines and stomach are only used for a few days before being evacuated by the body. It is said that the body regenerates completely in 7 years! This is true in terms of the quantity of cells renewed... but qualitatively false. Some cells never regenerate (teeth, oocytes, etc.).

Some mammals replace their fur twice a year. This moult protects them from cold and humidity, but also enables them to maintain their camouflage function by adapting to seasonal changes.

🏢 organizations

The problem of Theseus' boat in antiquity will serve as an example here! If we replace one plank of Ulysses' boat, is it still the famous ship, or has it become something different? And if we change all the planks, can we still call it Ulysses' boat?

Observation of the living world would suggest that it doesn't matter what's changed, as long as the boat is still navigable.



RESILIENCE *strategies*

Living organisms have the ability to return to a functional equilibrium (initial or new) following a disturbance or change in their ecosystem.

Resilience strategies

Adapting form to function

Forms and functions co-evolve constantly (on the basis of trial and error and natural selection) to best adapt to the environment.

#adaptation
#method
#co-evolution



on the living side

And no, the giraffe didn't acquire a long neck to fetch high branches! Those with longer necks, by chance or by mistake, had access to less coveted resources, and therefore reproduced better. Their long necks, enabling them to find their ecological niche at height, are therefore the result of natural selection over the course of evolution.

Another example of evolution in a bird is the Galapagos finch. After several droughts, the seeds on which they feed became increasingly hard, leading to a gradual increase in the size of the finches' beaks in order to break these rigid seeds.

organizations

Erasme's UrbanLab is adapted to its primary function as a laboratory for collective innovation: a moving, recreational, modular and inspiring space to welcome, encourage contact and imagination. Above all, it is adaptable to the different formats Erasme offers.



Encouraging diversity

In nature, the emergence of diversity is not hindered, as it promotes long-term robustness. It exists in individuals and organisms, as well as in relationships and ways of doing things.



##interactions
#variants
#complementarity

Promote functional redundancy

Living organisms multiply functions and information to secure the achievement of objectives or targets. A balance is thus maintained in terms of possibilities and ecosystems, enabling adaptation in the event of change.



#margin
#anticipation
#preservation

on the living side

Ecosystems that are most resilient to crises are those with high species and genetic diversity. Diversity is naturally present within each animal or plant species. In the event of sudden environmental change, the overall survival of the species will be ensured by those individuals possessing one or more characteristics that give them an advantage in the new context.

However, our cultivation and breeding methods run counter to this principle: we have selected the hens with the highest egg-laying yield, or the tomato plants with the largest fruit. A benefit for humans, not for the living beings themselves.

organizations

Crops that mix species are more resistant to disease attack and seem to last better over time. This is the principle used in permaculture through the trucking technique: it involves associating certain plants with each other, avoiding the use of chemical fertilizers!

on the living side

Grazing fish and herbivorous sea urchins feed on algae, preventing their excessive proliferation and the destruction of reefs. Should one of these species no longer be able to perform its function, the other will take over, ensuring that the ecosystem is maintained.

In tropical forests, fruit seeds are dispersed by a variety of mammals ranging from mice to chimpanzees. Smaller species are more likely to be affected by local disruptive events, but seed dispersal will still be ensured by the larger, more mobile mammals.

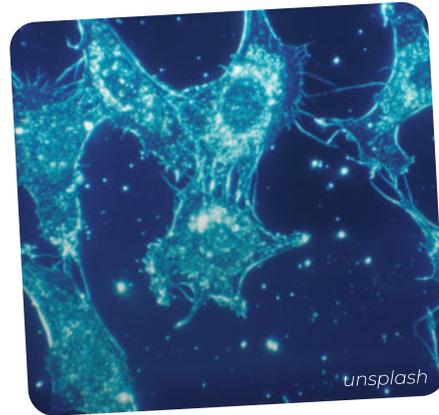
organizations

In a nuclear power plant, everything is doubled up: two production units, two pumping stations, two control rooms, and so on.

Each production unit has redundant circuits. In the event of a malfunction in one of the circuits (channel A), the second (channel B) automatically takes over to ensure continuity. This changeover from one circuit to the other is carried out regularly, ensuring that both are working at all times.

Favoring randomness

Trial and error is a fundamental method of problem solving. It is characterized by a series of trials, continued until the search is successful, or until the tester stops searching.



#trial and error
#experimentation
#evolution

Integrate the unexpected / plasticity

When external disturbances occur, the behavior and characteristics of living things change. So sacrificing an element can sometimes prove to be a profitable strategy in times of crisis or need.



#crisis
#adaptation
#choice
#survival

on the living side

In its larval stage, the lacewing is a formidable aphid killer, killing over fifty aphids a day. To find their prey, they move around randomly. This random tactic optimizes the number of captures and plays a role in the survival of the species and the process of natural selection.

"Trial and error" is one of the pillars of natural selection. In cells or fibroblasts, proteins move randomly to ensure they reach their target (compensated for by redundancy).

organizations

Tactical (transitional) urbanism presents temporary developments that use easy-to-install devices and furnishings to demonstrate possible changes to the design of a public space.

These frugal, in-situ experiments serve as tests for potential perennial deployments.

on the living side

An opportunistic species is one that is highly adaptable. It occupies newly available habitats and survives in transitory, unpredictable environments. With little specialization, it modifies its feeding habits to colonize new areas (e.g.: carrion crow, bullfrog...).

Autotomy is the ability of certain animals (reptiles, invertebrates) to lose a part of their body voluntarily: lizards, for example, leave their tail in the hands of a predator to free themselves.

organizations

During the Covid health crisis, some companies were able to adapt to the situation by modifying their production and activities.

Toulouse-based Applications Laser Sud-Ouest, which used to specialize in laser cutting of various materials, has redirected its business to the manufacture of glass screens for point-of-sale counters (shops, pharmacies).

An example of production adaptation that saved the company and contributed to its resilience.

ROBUSTNESS _ CULTIVATING COOPERATION
IN TIMES OF CRISIS _ CIRCULARITY

OPENNESS _ BUILT FROM THE GROUND UP _
SYSTEMIC ECOSYSTEM SERVICES

BE CLOSED BUT OPEN TO THE OUTSIDE
WORLD_ FUNCTIONAL REDUNDANCY
FUNCTIONAL REDUNDANCY_ ENCOURAGE
INTERACTION_ RESILIENCE_
SPECIALISATION_ DECENTRALISATION
_SUB-OPTIMISE_SELF-REPAIR

INTEGRATE THE UNEXPECTED &
DEMONSTRATE PLASTICITY_ DIVERSITY_
ADAPTABILITY -FAVOUR RANDOMNESS &
REPLICATE SUCCESSFUL STRATEGIES _
CYCLICAL PROCESSES





LET'S CONTINUE TOGETHER!

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