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Mother Nature in a Given World: Solving the Problem of Nanotechnological Precaution

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Abstract

The development, use and application of nanotechnologies is one step away from being controlled by the technology itself. It is a scenario under construction, called the Given World in an Informational Society, subject to control by digital citizens: the infoviduos who, organically and non-organically, interfere with the network to hybridize socially and, with this, build, from the data of the network, horizontal control over all forms of development, especially, inform the nanotechnological precaution beyond politics and economics. The methodology has a systemic approach and deductive method. It uses as research techniques the collection of indirect data, the bibliographic review, national and foreign. The results indicate that, if the Organizations do not make the data available to inform and make known to society, the control project will be stagnant and the precaution, once again, relegated to the convenience and political and economic opportunity.

Keywords: Nanotechnology; Risk; World Dado; Control; Digital Citizenship

Abbreviations: ISO: International Standard Organization; LIODS: Laboratory of Innovation; Intelligence and SDGs.

Introduction

The universe of new technologies has propelled society to disruptive movements that interrupt with the historical, social, political, economic, and cultural processes of, until then; innovate in other senses, significantly altering the course of history of human understanding of itself and the best way to survive from the transformation of natural resources: today, applied and technological studies emerge to spare future generations from the impacts of this path. With this, society is immersed in the digitization of every form of human activity, whether of the natural or artificial ecosystem. They are all allocated in the Informational Society producing knowledge in a global network. It is about the Given World and the digital citizenship exercised by the infoviduo.

By using as a time frame the advent of the Internet network, back in 1990 and its popularization and commercial use that, soon after, gave rise to the publication of the Green Paper of the Information Society in 2000, it appears that all these changes that are being experienced, are structuring the Network Society, cultural globalization, economic and technological and, above all, the economic system of the New Economy that makes the Fourth Industrial Revolution work.

It is in this scenario where the world is given that nanotechnologies occupy a leading position alongside the

environment, in the sense of sparing its use and replacing it in all forms of observation of nature. The promise of nanotechnologies is to copy nature and reproduce it in the laboratory, replacing natural extraction for the sake of environmental protection for future generations. But still, externalities, not yet measurable, are expected. This means that, along with the benefits, the harms; along with development, risk; along with decision making, (un) responsibility.

Because of this paradox that pervades development versus risk; Promise versus side effects, is that the precautionary principle presents itself as a ruler that guides decision-making on nanotechnological increments in counterpart to environmental risks and human health.

Still, however, the problem has not been resolved. Precaution is a principle filled in depending on convenience and opportunity, culture, investments, politics, education, etc. Even though precaution is the ruler of the ethics of responsibility for decision-making, the concept of precaution that should be applied is emptied of a single sense of language between governments, peoples, and cultures, therefore fallible to fulfil its purposes of perpetuating the global environmental ecosystem for future generations. Therein lies still a problem for research.

Therefore, the investigation starts from the following question: under what condition could the nanotechnological precautionary principle be fulfilled for environmental preservation, currently?

The initial answer is that the precautionary principle must be filled with the Given World, exchanging space of the legal and/or political philosophical hermeneutics that interprets and applies it for the universe of networked data collected and stored by all the actors that feed back into the network of networks; data produced by the knowledge society, a place where the environment has a seat and voice through the uniqueness of the data.

To pursue the answer, the research has as general objective to demonstrate that the Information Society is the place of presence and action of the infovíduo on the digital citizenship that can act on the nanotechnological decision-making and enforce, by data of the network, the principle of environmental precaution. And, as specific objectives, to present the scenario of the Information Society and the Given World; digital citizenship and the production of data in a democratic network of information and knowledge; the possibility of the infoviduo taking a seat in the process of nanotechnological management, in the public and private spheres.

The applied methodology has a systemic approach; deductive method and research techniques that include national and foreign bibliographic review, indirect data collection and qualitative analysis. The direct quotations extracted from texts in which the language used was not in English, went through free translation.

The results point towards the validation of the proposal, but there is still a need for organizational and institutional political openness, so that the bridge that separates the infoviduo and the democratic participation of the data produced in the Information Society network have space for interaction to inform the principle of nanotechnological precaution.

Nanotechnologies and the Environment: Both in a Common Place of Precautionary Policy and Precaution with Policy

In this sense, the object of research is the development and application of nanotechnology, that is, that molecular or atomic technology that, not seen with the naked eye (10-9), impacting, considerably, on the legal relationship between the cause, the effect, and the emerging damages liable to liability before the life cycle of a nano particulate product end with environmental disposal. Even though, it is the panacea of the century, numerous solutions, contrary to common sense, represent risk and uncertainty.

Recently, the European Commission concluded the review of the physic-chemical characteristics of nanomaterials established in 2011 [1], providing about the new identity as a parameter of rationality for the risk that: Nanomaterial means natural, incidental or manufactured material consisting of solid particles that are present alone or as identifiable constituent particles in aggregates or aggregates in which 50% or more of the particles in the number size distribution meet one of the following conditions: a) one or more external dimensions of the particle are in the size range of 1nm to 100nm; or, b) the particle has an elongated shape, such as a rod, fiber or tube, the external dimensions of which do not satisfy point ‘a’, but where at least one external dimension is less than 1nm; or, c) the particle is plate-shaped, whose external dimensions do not satisfy point ‘a’, but where an external dimension is less than 1nm. Particles with at least two orthogonal dimensions greater than 100 micrometers should not be counted for the purpose of the number size distribution. A material with a specific surface area per volume of 5m2/cm3 or less should not be considered a nanomaterial [1].

The above definitions and differentiations do not matter for the result of the research, in view of not settling the

search for data on the probability of emerging damage to the environment, because the nanoparticles of persistent tract, not biodegradable, it is already known, run into the probability of damage and environmental concern and human health.

The environmental issue, with much research around the world, continues to demand more political attention aggravated by the technological disruptive scenario, with nanotechnology being highlighted in the environmental impacts in the face of the dimension of its applications. The importance of the volume of environmental research published around the world remains, with Brazil occupying the 2nd position in the global ranking, according to the Organization for Economic Cooperation and Development, according to 2020 indicators [2].

Even though nanotechnology is promissory note on the one hand; on the other hand, some properties can cause toxicity to living systems such as cellular, molecular, and atomic identity, and therefore the effects of this natural-living approach with the nanoparticle-technology are unpredictable. So why would technoscience add risk over risk at the expense of safe living for present and future generations? What kind of rationality applies when deciding on this? What kind of political direction is behind this implication? Why are principles such as prevention and precaution so difficult to consider? Why doesn't environmental research resonate in decision-making? These are questions that remain in this environment and, once again, the research seeks to contribute to the search for a solution.

According to Beck [3], we are experiencing the society that assumes the risk – which is diluted over time and gradually, hence the procrastination in investment in scientific certainty regarding the safety of nanotechnological applications – in the name of the necessary and accelerated development of developing countries, such as Brazil, the emancipation of the developed condition. Beck further explains that "in late modernity, the social production of wealth is systematically accompanied by the social production of risks" [3]. This means that, alongside the "problems and distributive conflicts of the society of scarcity, overlap the problems and conflicts arising from the production, definition and distribution of scientific-technologically produced risks" [3].

This permissive and at the same time contradictory logic accompanies the treatment of nanotechnological decision-making when, even without the scientific certainty that measures the probability of a harmful event – which in the case of nanotechnologies is aggravated by uncertainty and ignorance aggravates the legal situation – it emerges as a solution to problems of scarcity of daily life and occupies space for political decision divorced from the ethics of responsibility [4].

For Galimberti, this stems from the capture of politics by economics, which has stripped it of the elementary bases of decision "[...] today politics no longer seems to be the place of decision, because, to decide, it must look at the economy, and the economy, in turn, to decide its investments, looks at technological availability and resources" [5].

On the other hand, Friedman [6] considered that, since the 2000s, the world has moved from the verticalization of command and control to the horizontalization of connectivity and collaboration, whose changes have not only affected how business is done. Above all, this does not happen all at once, not even overnight, but "over time, many roles, habits, political identities and management practices that we have become accustomed to in the round world will have to be deeply adjusted to the era of flattening" [6].

It is, therefore, a process of restructuring capitalism itself, which, when quoting Marx and his work "Communist Manifesto" of 1848, already mentioned that "in his texts on capitalism – the inexorable march of technology and capital towards the removal of any and all barriers, borders, friction and restrictions to global trade" [6], whose implements were already happening, since then, consolidating the march with the technological outcome henceforth.

For Pinto [7], the technological panacea communicated to man has the political objective of domination over the restlessness with current social injustices so that he is "convinced that the defects of the present world result from technological imperfections not yet corrected by the action of intelligence" [7]. And he goes on to explain that thus social problems based on a social reality of material bases "are transformed into an abstract, scientific intellectual problem, that of the invasion of better techniques" [7].

Regardless of the perspectives of the aforementioned authors regarding the problems of risks, uncertainties and the very fetish of technology in the present day if, of late modernity; if, due to the absence of ethics of responsibility; or whether the system of politics has been captured by economics; If it is a question of global expansion of capitalism or social domination, the fact is that the scenario that is designed for the future is permeated by the emerging possibility of undesirable events to the living ecosystem, either by aggression, degradation, deposit, mutation, irreversibility, loss and damage.

In addition to these possibilities, there are others that threaten human existence itself with such disruption/deviation/technological disruption, that is, those of the

"cultural rules, that is, of the hereditary technical practice, is deadly for the individual and for the community" [8]. That is why, when dealing with the phenomenon of technology, there is a possibility of increasing the universe of possibilities of intervention in the media network that, "seen from the perspective of social reality, this means becoming a producer, the subject of economic activity, in the broadest sense of the word" [8]. That is, the social appropriation of as much as possible of all technological development through platforms of democratic intervention. This means evoking shared responsibility with the communication of cultural standards that safeguard sustainable decision-making.

Consequently, the demand for cultural validation, not only political, economic, or legal of the precautionary principle, but of pragmatic citizenship, of horizontal empowerment over the zones of collaboration and network control "because current scientific research suggests that exposure to some nanomaterials, nano-devices or products derived from nanobiotechnology can cause damage to health and the environment" [9]. And this matters to the whole society to appropriate that is, the has is of public interest.

According to Pellin and Engelmann, precaution and prevention are different categories of caution. For the aurors, "prevention deals with risk, from the knowledge data, scientifically and economically. Precaution does not" [10]. They go on to explain that precaution should be taken into account when "there is scientific doubt about the impact of development, both for products and for people or the environment" [10], They maintain that it is a "dispute for rationality, limited as a reason to govern corporate decisions regarding the social availability to bear nanotechnological risks" [10]. In Beck's expression, this "scientific rationality without social rationality is empty, social rationality without scientific rationality, blind" [3].

Even so, the risk society increases the volume of investments in planning, development, and industrial applications in products of all kinds of things with risks, leaving society on the margins of this process, reduced to a consumer of technological products as a national policy of quality of life and well-being [11]. This results, for Beck, in the demonstration that man has divorced God; a break with the Creator who raised humanity to the opium of technology: "when risk entered the agenda, God was forced to abandon his position as leader of the world, with all the subversive consequences that this entailed [12].

However, when it comes to nanotechnology, use as an input and consumption as a product are already realities. Nanotechnologies are accompanied by far-reaching promises, such as advances in medicine, in the reduction of environmental impacts, in the development of new technological applications, in the improvement of the performance of inputs and products, etc. composing the technological arsenal of the Fourth Industrial Revolution [13,14] for better productivity and promotion of quality of life.

According to StatNano's database of nanotechnology-based products [15], 9,195 products with nanomaterials are being produced by 2,633 companies distributed among 64 countries, including, in the indicator, Brazil. Then distributed according to the Table 1 that impresses by the collection of products, volume and nanotechnological applications in the most diverse areas of inputs for industry and products for consumption, without the consumer citizens knowing it.

Sector	Products	Enterprises	Countries
Agriculture	232	75	26
Construction	889	396	41
Electronic	1933	108	19
Food	357	142	26
Drug	1121	412	44
Petroleum	293	121	27
Renewable Energy	298	145	28
Textile	807	490	42
Sports and Fitness	150	43	23
Impression	154	67	19
Other	520	255	36
Appliance	334	133	25
Environment	560	247	34
Cosmetics	889	267	30
Automotive	658	200	38

Source: Prepared by the author.

Table 1: List of Products, Companies and Countries in the production and nanotechnological application.

But, if it is possible to diagnose a ground zero on the responsibility in this paradoxical system, one can adopt the moment of decision-making, above all, of which elementary and/or variables are elected to interfere and or gravitate as patterns of orientations now of choice – yes or no – by the magic of nanotechnological development. For the achievement of the enterprise, it means considering, not with variable, but as elementary, the precautionary principle along with the calculation of the economic enterprise, inherent to the prediction, motivation and incentives for technological development, capable of changing the decision making and, therefore, the results.

It is from the Notebook of Principles for the supervision of nanotechnology and nanomaterials, published by NanoAction [9], a global initiative of the International Centre for Technology Assessment, the finding, among many other information, of the need to imply the precautionary principle in the nanotechnological treatment, stating that "a precautionary approach requires the existence of mandatory nano specific supervision mechanisms that consider the typical characteristics of materials" [9] and, in the face of any threat to human health or the environment, "precautionary measures should be taken, even when the relations of cause and effect are not fully established in a scientific way" [16].

According to Berwig [17], this "precaution is taken as a necessary command to be evoked in the face of scientific uncertainties. The focus should therefore be on assigning the burden of protection to those responsible for potentially harmful activities [...]" [17]. And it goes on to say that in the case of nanotechnologies, "research suggests that exposure to at least some nanoparticles can cause serious harm to human health and the environment" [17].

The technical-analytical categorization of biodegradable and biopersistent nanoparticles is already present in the frameworks of the International Standard Organization (ISO) through the ISO TC 229 Technical Committee of 2017 [16] and, here, in Brazil, through the internalization of standards by the Brazilian Association of Technical Standards, and the dwarf problem is only in the cataloguing of physicochemical categories of nanoparticles, but in the implications arising from its development, application and disposal with harmful potentialities to human and environmental health without the production of knowledge, but in a scientific regime of risk and uncertainty. Therefore, the proposal must go further in dealing with precaution.

In addition to the catalogue, risk management has already been treated from the ISO Standards [16] in a global way, to safeguard, by standards, work environment and laboratory, which means "To develop nanotechnology in the context of international economies there are generated debates around their possible regulations and organization, that is, around governance frameworks" [18]. But, in addition to the governance that has been implemented as an organizational culture in the global scenario, these standards that are intended to be achieved with the ISSO norms not only standardize responsible behaviours, but, above all, inform the recipient of the development about the risks and benefits, but do not deal with the precautionary activity, only preventive. See: It is prioritized as a great objective to guarantee access to knowledge in an open to international level, to bring to tune the emerging countries until reaching a minimum scientific competence that facilitates the implementation of global standards and above all, an ethical imperative to disseminate the benefits and rigorously know the risks derived from the development of nanoproducts [18].

As an example of the danger being considered, in Spain news has been reported that researchers from the Consejo Superior de Investigaciones Cientificas have diagnosed considerable concentrations of fullerene nanotoxics, characterized by spherical molecules capable of transporting dangerous substances in the wastewater of Catalonia reaching the whole of Spain. The news reported that 19,100 nanograms of fullerene C60 per liter were collected in the Sabadell River and 14,400 nanograms in the Bésos River, both of which flow into the Mediterranean Sea [19].

Already, the Instituto de Investigaciones Químicas y Ambientales de Barcelona explained that some persistent contaminants such as polychlorinated bifelines and dioxins, can be introduced into these tiny spherical fullerene capsules achieving stability by encapsulation and start to serve as an armoured vehicle to transport these more toxic properties throughout the river route reaching agricultural production [19].

Fullerenes are adopted by industries as one of the most promising synthesizing materials in the history of science, which are applied in the manufacture of sun creams, pharmaceuticals, electronic devices, automotive and footwear even without an environmental impact study. They constitute a class of stable spheroidal nanomolecules formed exclusively by carbon atoms. Unlike other allotropic forms of carbon, such as graphite, diamond and nanotubes, fullerenes are a molecular form of carbon [20] with highly harmful potentialities.

This same Spanish scenario is repeated in another investigation carried out by the Instituto de Diagnostico Ambiental y Estudios del Agua that found in another river, Llobregat, excessive amounts of nanoparticles from waste generated around El Prat Airport [19]. And as for the likelihood of environmental damage and human health, the researcher Marinella Farrè, from the respective institute, stated at the time that: [...] It is difficult to establish whether the levels found in the Catalan rivers are raised or not. To do this, the researchers have compared with the waters of less industrialized regions, such as those of Manresa, and have concluded that, effectively, the concentrations of these nanoparticles are 'quite high' [19].

Although this Spanish photograph is not the Brazilian one, the probability of this scenario being repeated at this very moment of the research leads to conclude that the same impacts are occurring anywhere in the world involved with this development, application, and disposal, generating unpredictable impacts on human and environmental health,

precisely because of the size that invades the most intimate sphere of living cellular life.

Recently, the NanoDataBase [21] published a report by scientists at Swansea University on the discovery of potentially dangerous pollutants, including copper, that are being released inside the plastic and silicone fibers of ordinary disposable face masks, when submerged in water, i.e., discarded. The leader of the research project, Dr Sarper Sarp, mentioned that far beyond the need for mask-wearing to contain the pandemic lies the problem of environmental and human health impacts in the face of results that revealed significant levels of pollutants in all the masks tested, with nanoparticles and heavy metals released into the water during the tests. As a conclusion, he stressed that the environmental impact will be substantial and the issue of damage to public health will emerge, where repeated exposure can be dangerous because the substances have links with cell death, genotoxicity, and cancer formation.

The United Nations has been considering, since 2000, the benefits of development in nanotechnologies without ignoring the risks and uncertainties considered from a balanced approach to apply nanotechnology in water, for example, in view of the risks associated with toxicology and the impacts on man and the environment. In addition, it considered that, in this environment of uncertainties, debates should be focused on ethical issues, whose community involvement in deciding on the application of technology to local needs should be the subject of discussion, to ensure clean water in developing countries [22], for example. The European Food Safety Agency published an opinion on titanium dioxide (E171), another nanoparticulate component, finding that it was no longer considered safe, in part, because researchers were unable to exclude the genotoxicity of the nanoparticulate component.

It is not new that the environmental treatment is a subject that dates to the global deficit of regulation and normative retrogression [23], threatening the planet of irrecoverable natural catastrophes and that threaten the existence of every living biological agent.

The precautionary principle has already been discussed on another occasion in an attempt to get it out of the rhetoric that handles it for convenience and political and economic opportunity, national and global, the result of which does not conform to the discourse. It has already been proposed that the precautionary principle be understood and applied with a semantic cut in the search for a better and more adequate interpretation that approaches systemic pragmatics and uniformity, separating what would be the principle from what would be precaution, as follows: But this, the search will be to break the precautionary principle in two interpretations of meaning: the first part is the principle and politics and decision-making, understood as ethical that permeates the conforming constitutional principles of society as a whole; The second part, the precaution, which will be directed by the sieve of natural and economic science for, therefore, the duty of transparency, creates the data for the assumption of parameters or repulsion to risks, especially the measurement of the possible cost of economic benefit [24].

Nevertheless, a decision taken based on precaution should assume, for example, that: "a) the potentially dangerous effects arising from a phenomenon, a product or a process are identified; b) there is a scientific assessment of the risks that, due to insufficient data, cannot be determined with sufficient certainty" [23].

Therefore, faced with the problem of the absence of scientific certainty and the insufficiency of technical data about the probability and dimension of harmful events that guide the pragmatic application of the precautionary principle, it is necessary that the policy of precaution and the precaution with the policy be resumed in the perspective of the research hypothesis, according to the production of data in the network by the informational society, whose control in a regime of collaboration and horizontality is carried out by the infovíduo of digital citizenship. This is what the research comes to consider as an answer to the problem.

Solving Nanotechnological Precaution with the Given World

In order to consolidate the hypothesis, it is necessary to understand the extent, depth and width of the context in which the solution is presented, since the timeline shows that the principle of environmental precaution can be solved from a world in transformation by data whose management of all social processes derive or will result from the digital citizenship exercised by the infoviduo, thus considered as the "complex network of interactions that we inhabit in which we compose our plural person" [25]. This is the infoviduo, for a better understanding of the whole "inseparable from the physical and digital person, the first organic and the second composed of the online data set and digital profiles" [25] represented by digital citizens living in the Information Society; which has Brazil as a part, since 2000, with the publication of the Green Book [26].

The impact of this publication by the Ministry of Science and Technology was the inclusion of Brazil in the economic, cultural and technological globalization that, according to Lisbon, has been implemented since the 1960s, when the first computers were manufactured that modified the global scenario with the following transformations: a) the transnationalization and the emergence of economic blocs;

b) e-commerce; c) the economics of the information; d) the formation of a database; e) the electronic transfer of data; f) the establishment of Community standards [27].

This Information Society [27,28] has the nature of a socioeconomic project for the implementation of another type of society, the global communication network, with another type of social culture, the informational. This Society, also nicknamed the Knowledge Society, described by Lisbon, can be characterized as: [...] Expression used to identify the historical period from the preponderance of information on the means of production and the distribution of goods in society, which was established from the vulgarization of the data schedules used by the existing media and the data obtained about a person and / or object, for the performance of legal acts and business [27].

The affirmation that the Green Paper deals with a model of society different from that rooted in the historical process of humanity stems from its own content by listing a set of actions for its achievement, starting with the challenges that Society and Government would need to face to achieve goals, among them: information and communication technology infrastructure, Internet viability for everyone in the country; Information Infrastructure, Education for Citizenship; institution of Electronic Commerce; investments in Research and Development; the culture of the New Economy and the change of National Policy.

Since then, the country has undergone significant transformations in the structures of the national system in all its complexity, including investments in all the goals that make up the agenda; Just check the pages of accesses to organizations, political institutions, and government funding, as well as the legal changes, especially in the organizational culture of legal, economic, political and cultural activities, since 2000.

In the theoretical perspective of Luhmann N [29], it could be affirmed that one is facing the deconstruction/destruction of the historical system of humanity as a social organization, for the uplift of another system, the social-informational; disruptive [13,14], understood as the interruption of the anthropological historical process; destroyed its bases, structures, and functioning.

It is not about increasing what was already consolidated; it is not about the evolution of humanity; it is about the different, the new; disconnected from the previous process; it is about the new normal, the systemic reset; other relations of interdependence between the social whole and its subsystems, horizontalized by information, communication, and knowledge in the media network. A crisis of civilization, according to Mattelart [28], aggravated by the coronavirus pandemic, which ended up leveraging the forced process of migration of most of the population and economic and cultural productivity to the networked system, territory of the Information Society, which contains in itself, the economy structured from the Fourth Industrial Revolution and its functioning through the New Economy: e-commerce, big data, IoT, Artificial Intelligence, Biotechnologies, Multidimensional Printing, Robotics, Machine Learning, neurotechnologies, virtual and augmented reality, space technologies [26,14].

In this sense, one of the fundamental impacts of the implementation of this project of change on social structures in the domains of human activity and experience lies in the action of the political subject that tends to "become global, more diffuse and less openly authoritarian, seeking to reduce social conflict through a participation dependent on those submitted to the apparatuses of economic and political decision-making" [28]. Above all, "the overlaps, confusions and equivalences between information, knowledge, culture and communication will be recurrent" [28]; motivated to empowerment through the media organization of collective demonstrations, among them, environmental protection, and warnings of technological harms.

And, because of this impact on the political subject that, "as a historical trend, the dominant functions and processes in the information age are increasingly organized around networks" [3].

This network organization constitutes "the new social morphology of our societies and the diffusion of the logic of networks substantially modifies the operation and results of productive processes and experience, power and culture" [30], instrumentalized from information technologies and individual and fundamental guarantees, as well as civil and social rights, which also makes this process disruptive for the human psychosocial subject, enabling him to new competencies and abilities and, among them, to be an agent of intervention in the decision-making processes using the media network and the data network.

In this disruptive system, the environment occupies a prominent position for being well legally and politically protected by Globalization, the Federal Constitution of 1988, the protection of Human Rights and the 2030 Agenda, falling on the new technologies the duty to protect, not damage and to make themselves recover in the search for the quality of the living ecosystem; They must represent a solution and protection, not aggression and violence to sustainability. Therefore, "this logic of networks generates a social determination at a higher level than that of the specific social interests expressed through the networks: the power of the flow is more important than the flow of power" [30].

The consequence is the appropriation of social morphology on social action in this networked society, that is, the exercise of algorithmic digital citizenship that has an impact on the legitimation of legal power and, consequently, on decision-making by the majority, that is, "Currently, within a community, power is legitimized by the consent, freely expressed, on the majority of those who are part of this community." [31].

Algorithmic digital citizenship has the power to fill the global gap in the precautionary principle that prevents it from enforcing the control of nanotechnological decision-making parameters in the face of uncertainties and risks. Today, it is not only scientific activity that produces valid information and knowledge. There is a Given World [32]. This means that forests, rivers, ecosystems and climate gain spaces of interactivity in an ecosystem of intelligence by transforming themselves into data within the information network that, through dynamic processes and self-learning systems from inputs / outputs are able to generate answers, more data, more interactivity and more transformative information, Feeding back into a functioning artificial ecosystem capable of providing subsidies because of "our connected societies, everything has become measurable and quantifiable" [25].

In the perspective of Accoto's Given World, there are two dimensions of reality: the first of the world as given reality; closed entity; the second, as the data-world, as a quantified entity, made from and from data [25]. In this informational ecosystem where human and non-human actors, organic or inorganic, are algorithmized in the Dado World, "forests, climate, rivers, through sensors and connection technologies, have begun to communicate and interact with us expanding our ecological conception [25]. Therefore, "automated forms of digital calculation have thus replaced statistics and human data production, giving numerical information a new political dimension, capable of developing new functions" [25] and, therefore, able to fulfil the principle of nanotechnological precaution through various information accessible on the network, above all, produced by social actors other than institutions and organizations.

As an example of what is being considered as a hypothesis and as a sampling of the tendency of Mother Nature in a Given World, recently, the National Council of Justice launched the SireneJud system [33] as a response to article 225 of the Constitution of the Republic, to Goals 13 and 15 of the Sustainable Development of the 2030 Agenda and goal 12 of the CNJ; also as a response to the report of Justice and Socio-Environmental Protection in the Brazilian Amazon committed to the Delegation of the European Union in Brazil and, finally, as a response to the Paris Agreement. In addition, it had committed itself to the development of a methodology to control and combat environmental infractions of deforestation and degradation.

It is a national interactive panel of environmental and interinstitutional data. It is an integrated database of open data on Public Forests and Indigenous Lands that was based on research conducted by the Laboratory of Innovation, Intelligence and SDGs (LIODS) under the coordination of the Permanent Commission of the 2030 Agenda of the CNJ on Brazilian Public Forests registered with the Brazilian Forest Service. This SireneJud system aims to be a data integration hub that enables strategic monitoring of land use. It is possible through the database to generate maps and statistical reports that will enable the organs of the Judiciary and the Public Prosecutor's Office to obtain the real notion of the size and where the environmental violations occur in the country discussed in lawsuits or object of Terms of Adjustment of Conduct.

In the sense of the research, the SireneJud system should compose an arsenal of public data and of access and active participation by other organic entities, such as organizations and institutions, and inorganic, such as data in constant process of interaction with other databases, composing a single communication and information system that feeds back other data that can be collated to the precaution; Data from the environment of digital citizenship organized by the network of information interested in democratic and horizontal participation on the verification of environmental precaution. It is, therefore, following the example of this database initiative, that hazard information can be extracted and organized in the case of nanotechnologies.

This process of participatory social construction through big data [34], artificial intelligence and internet of things in the Information Society makes up the informational arsenal that makes work the subjective right to enforce aspects of Human Rights that must be exercised in the environment of digital citizenship with the objective of materializing active participation in social life and decision-making taking into account the data of the network to deal with the precaution and the transformation of society. To consolidate this reasoning, in Mattelart's understanding, "there cannot be a diversified knowledge society without a questioning of the relations between knowledge and power and, therefore, of the status to be occupied by all producers of knowledge" [34].

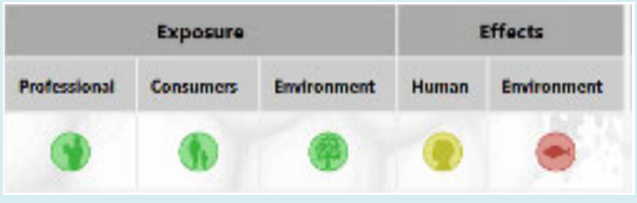
This is sustained because we are facing the common good that opposes the privatization of nanotechnologies as possible harms to the common environmental heritage. By this principle of the common good motivated are the "social mobilizations not only around communication and knowledge, but also health, life, the environment, water, software and the spectrum of broadcasting" [34].

For all this exercise, then, transparency with the disclosure of public data and equal access to information is not enough, such as the CNJ's initiative with the SireneJud Project restricting environmental protection to the agency itself and to the Public Prosecutor's Office, there is a need to go further; a qualitative leap in citizen inclusion-participation in knowledge and management of the risk and uncertainty of environmental damage for responsible and shared decision-making within organizations, public or private, given the importance that the theme of precaution demands and the common environmental good protected.

Mattelart states that "if there can be no communication policies without cultural policies, there can be no more communication and culture policies without knowledge policies" [34]. This author goes on to argue that this "new regime of valuing the capital of the products of the spirit, such as culture, communication, information and knowledge, has actually opened a new field of cultural, social and economic struggles, all at the same time" [34], as is being considered.

As an example of going further to the fulfilment of the precautionary principle by the infoviduo and the exercise of digital citizenship in the Information Society for the control of nanotechnological harms, there is the initiative in Denmark involving the Danish Consumer Council, Danish Ecological Council in cooperation with the Danish Ministry of Environment Protection Agency and the Technical University of Denmark by developing a database platform called NanoDataBase, which assists, in cooperation and collaboration, consumers in the identification of more than 1,200 nanocompatible products, with information, cataloguing and methodological risk assessment called NanoRiskCat [35].

This methodology was developed to point out, in the cataloguing of nanoparticle identities, those that offer a probability of damage to human and environmental health. It is composed of four safety informational categories, the red one representing the probability of toxicity; the yellow one of medium probability of toxicity; and the green of no human or environmental toxicity, represented by the Figure 1 below:



Source: NanoDataBase.
Figure 1: NanoRiskCat Methodology.

The reference of the colour code attributed to the human risks associated with the nanoform of a given material is based mainly on the opinion of scientific experts added to the holistic evaluation of the evidence of mutagenicity, carcinogenicity, respiratory toxicity etc., and the scientific literature varies, as well as the conclusion reached and the colour code of the human danger attributed to the nanomaterial [36]. With this methodology built from the list of nanomaterials, it is possible to adequately fulfil the precautionary principle beyond the policy of occasion or the ethics of responsibility. In this database, nanotechnologies are in the Given World and therefore appropriated by the infoviduo network.

This makes it possible to make decisions about risk because uncertainty has been removed and probability has been brought about. This is an example of success that serves as a mirror for other initiatives in the sector. However, there is resistance to this opening. Historically, in countries of late modernity (sic) the instrumentality of forms is more prestigious than systemic pragmatics, maintaining the bridge that separates society from legitimized power, even though, everything is done and promised in the name of that same society [37].

Between the Organic Society and the Informational Society there is still much to bring together. The pandemic has accelerated the process. There is resistance to merging with infoviduo, above all, to recognize its role in public mediation between the State and the Market. This route presents itself as an appropriate response. Although it has already been happening under global guidance, in Brazil, there is a delay in this fusion between the Natural World and the Data World of infoviduo, preventing the total empowerment in the network of digital citizenship that goes beyond the media network to the complex network of information and data available to produce knowledge [38].

Final Considerations

The time has come to answer the initial research question: under what condition could the nanotechnological precautionary principle be fulfilled for environmental preservation, currently?

Faced with the whole course of research, mother nature can be better protected by the system of the Data World whose territory and government is structured in a network of networks and feeds back to data; information capable of generating knowledge in a digital citizenship network, whose functioning results from the activity and intervention of the infoviduo. With this, the scientific vacuum (risk and uncertainty) about nanotechnological information can be filled by the available data of the complex network of

interactions to the production of knowledge about risk and probability and, therefore, inform the precautionary principle of data that contribute to nanotechnological decision-making beyond – few or no – institutional data.

For this, the principle of nanotechnological precaution must be understood as a common good and, therefore, have the nature of a Human Right expropriating decision-making by private initiative, in the face of the impact on the social and environmental whole Although everything seems new to us, in truth, it is, cyclically, in the reason of time and space, repeated under other guises.

What is different, then, in this new guise, is the tool for the increase of architecture: the new network technologies of the networks, which have, as a predictive scenario, absolute and non-marginalized empowerment.

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